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Technical Workers in the Public Service

The large majority of technical workers in agricultural science in this country practise their profession in the capacity of officers of the Public Service and it is a matter for regret that in so many respects the conditions of employ are not as satisfactory as the nature and importance of the services demand. That this state of affairs exists in at least a number of centres in the Commonwealth is apparent both from the recent departures of departmental specialists to accept posts in private research institutions or with commercial firms, and the published statement that others too would welcome the opportunity to enter on fresh fields offering greater remuneration and scope for their training and experience. Indeed, it is surprising that where staff defections have occurred in recent years, the matter has not been more fully investigated by the controlling bodies concerned.

Scientific organisations throughout the world have frequently drawn attention to the question of emolument in the case of scientific workers, and the inadequacy of the salaries paid to agricultural specialists in government employ in this country is apparent to anyone who has made even a casual survey of the position. The matter was recently commented on in incisive terms by a number of organisations including the N.S.W. Graziers' Association, Australian Veterinary Association, and organised groups of primary producers—bodies which fully appreciate the serious plight in which both the Departments of Agriculture and the standard of agricultural services will be placed unless adequate measures are taken to stem the drift of trained and experienced workers.

It is agreed that administrative posts always command salaries far in excess of those paid to technical workers, and the margin of difference is, in most cases, out of all proportion to the value of the services of the trained investigator. The administrator must necessarily depend on the counsel of his experts, and the success of his administration is a reflection of the competence of the technical staff associated with him. Until this fact is more generally appreciated and the obvious remedy applied, it is unlikely that young men who have spent four to five years at a university equipping themselves for specialised work in the country's most important industries, will continue to remain in the service of the State when more attractive conditions are offering elsewhere.

The present state of affairs is disturbing not only to the individuals and to the Departments, but also to the satisfactory and successful prosecution of the tasks with which the agricultural and veterinary specialists are confronted; and so long as Public Service Boards continue to take the view that defections in staff can be remedied by making further appointments—of men necessarily junior and inexperienced—to fill the " gaps," and then at the old rates of remuneration, little can be expected in the way of gaining for existing staffs the improved conditions which are so necessary if further defections—and, consequently, reduced efficiency—are to be avoided.

Not the least important function of Public Service Commissioners should be to ensure that the working conditions in the departments under their jurisdiction are conducive to the best results in the interests of the public generally, but maximum efficiency can only result if the officers themselves find contentment in the conditions of employ. There is no doubt that some features of the Public Service system require very drastic alteration from the standpoint of providing incentive and encouraging efficiency in the conduct of agricultural and veterinary work generally. It is questionable at present whether, with increased training and experience, a man can look forward within even a reasonable period to those responsibilities for which his qualifications and attainments befit him. And

to assume that a technical worker who is fully trained, capable and actually rendering service of definite economic importance to the State, should continue to perform his duties with no prospect of advancement in either salary or responsibility is only to assume something under which any intelligent person would soon become restive.

These are matters of national significance, for to be sure that men of the *required* calibre will enter the agricultural and veterinary professions in the future, it is evident that some readjustment of conditions generally is one of the pressing needs in the Public Service to-day.

Landmarks and Problems of Agricultural Science in Australia

Notes from the Presidential Address delivered by Prof. R. D. WATT before the S.U.A.G.A. and N.S. Wales Branch of the A.I.A.S. on 21st February, 1936.

When one contemplates the history of the land industries in Australia, it is impossible to withhold admiration for the amazing development that has taken place in the first 148 years of the white occupation. Although progress has been continuous it has not been uniform. Events have taken place which may be regarded as landmarks opening the way to much more rapid advancement than had been possible before. In the early days these landmarks frequently took the form of discoveries of new fertile lands and we of the present day are under an immense debt to the intrepid explorers who paved the way for the hardy pioneer settlers.

The successful occupation of these new districts would have been impossible but for the introduction of live-stock from Great Britain and elsewhere. The most fortunate importation of all was the merino sheep, a few of which were brought from South Africa in 1797, largely at the instigation of Captain John MacArthur, who thus laid the foundation of the wool industry which has been such an important contributor to the wealth of Australia.

The carrying capacity of grazing land was greatly increased by the introduction about 1840 by Mr. Henry Badgery, of the practice of ring-barking, which unfortunately has been much abused, while cheaper methods of clearing the land for the plough included the use of the mallee roller. Large scale agriculture was also facilitated by mechanical devices such as the stump-jump plough and the wheat "stripper," invented by John Ridley, of Adelaide, who thus paved the way for the more modern types of farming machinery.

Other landmarks making for general progress were the discovery of gold in 1851 which proved the cheapest and most effective immigration scheme Australia has ever had, and the development of that ever-expanding network of railways which affords cheap and rapid transport for pastoral and agricultural products.

It was not, however, until a little over half a century ago that agricultural science as we understand the term to-day took a prominent part in assisting rural development, and its effect in accelerating progress has been beyond calculation. Its first important contribution—refrigeration—was the result of research work carried out in Australia and commercialised by Thomas Sutcliff Mort, of Sydney, in the early part of last century. It would be difficult to exaggerate the value of this to the live-stock industry which was at its wits' end profitably to dispose of its surplus stock. It has probably meant even more to the dairying industry, entirely new possibilities for which were opened up by temperature control and by utilising products of the research workers of other lands such as the cream separator and the milk and cream tester. These would, of course, have been relatively valueless if alert and progressive men had not perceived their possibilities and evolved the co-operative butter factory system which, aided by science at every turn, has resulted in our great and rapidly expanding butter-export trade.

Although the live-stock and dairying industries were the first to benefit, it was not long before the agricultural industry was to have its turn; a definite landmark was the foundation of the first Agricultural College and the nucleus of the first State Department of Agriculture in South Australia in 1885. Out of the early investigations arose or were elaborated and gradually translated into regular farming practice, two of the greatest factors in building up the wheat-growing industry in Australia—viz., fallowing and the use of superphosphate. In connection with these the name of the late Wm. Lowrie, second principal of Roseworthy Agricultural College, should always be gratefully remembered. All the other States soon followed the lead of South Australia in the establishment of agricultural departments, and all—except Tasmania—in the founding of one or more agricultural colleges. It would again be difficult to estimate in pounds, shillings and pence the gain to the primary producers of Australia through the investigational, regulatory and instructional work of these various departments and colleges, but it would be the unanimous verdict of progressive farmers and graziers that it has been out of all proportion to the expenditure involved.

One great need towards the end of last century was the introduction or evolution of varieties of wheat specially adapted to our rather unusual environmental conditions, and too great credit can hardly be given to our pioneer plant-breeders amongst whom the most notable was the late Wm. Farrer, who joined the service of the Department of Agriculture in New South Wales in 1898.

Farrer's work can again be regarded as a definite landmark as he produced wheats which excelled all previous varieties in drought-resistance, early maturity, disease resistance and in quality and yield of grain, thus raising wheat-growing in the Commonwealth to a higher plane. He greatly inspired his contemporary plant-breeders like Pye and Marshall, and his long line of successors whose varieties have now largely replaced Farrer's, owe much of their inspiration to him.

The need for men with a more intensive training in the underlying fundamental sciences for many positions in the departments of agriculture was probably the main reason for the steps which were taken to establish Chairs of Agriculture in the various Australian Universities, and the foundation of the first of these chairs at Sydney in 1910 was another definite landmark in progress. Now every University in the Commonwealth, except again Tasmania, has its Faculty of Agriculture, and I need hardly say that the graduates—who form the great bulk of the members of the Australian Institute of Agricultural Science—are playing a very important part indeed in educational, research and investigational positions of the most diverse and useful kind.

The year 1916 may also be regarded as epoch making because in that year the Commonwealth entered the field of agricultural research by the establishment of the "Advisory Council of Science and Industry," to tackle problems which, by reason of their magnitude, could not be dealt with adequately by State departments of agriculture. Amongst other things, this Advisory Council set going the campaign against the prickly pear by the use of insect enemies, and this has proved to be one of the most successful examples of biological control on record. The Advisory Council was only regarded as a preliminary to a more permanent institution which was established by Act of Parliament in 1920 under the name of The Institute of Science and Industry, and was ultimately reorganised on better lines with more liberal financial assistance as the Council for Scientific and Industrial Research in 1926. Another definite, recent landmark was the foundation in 1927 of the first purely agricultural research institution resulting from private benefactions, viz., the Waite Institute near Adelaide. It has been linked up with the University of Adelaide and now receives Government grants in addition to other private benefactions, and it is to be hoped that it will prove the forerunner of similar institutions in other States.

The work of these two last-mentioned bodies is so recent that there is no need to refer to the many important results already achieved and now being translated into agricultural and pastoral practice. As much of the research work carried out by both is of a long-dated character, we can look forward to still greater achievements in the future.

Let us hope that 1935 will also be regarded as a landmark as the year in which our own Institute was founded to unite in a great brotherhood the qualified workers in agricultural science throughout the Commonwealth.

SOME PROBLEMS IN AGRICULTURAL SCIENCE

The main problem resolves itself into the making of the best use of our greatest asset—our land resources. To that end agricultural science can contribute, and is contributing, in two main directions, viz., education and research, using each of these terms in the broadest sense. Although the educational facilities for our present and future farmers are gradually increasing, there is still a very considerable lag in the putting into practice of the facts and principles which have been firmly established as the result of investigation and research in the field and laboratory. Indeed, one of the greatest needs for Australia to-day is a continuous increase in the agricultural extension service.

To attempt to give even a list of the problems which require further investigation would take a longer time than I have at my disposal. In connection with the soil alone, we have only touched the fringe of a survey classification of our soils along modern lines. There are many anomalies in the way of crop failures and response to fertilizers at present unexplained. There is much to be added to our knowledge of the connection between the soil and deficiency diseases of live-stock, and how little we know regarding the microscopic flora and fauna of our soils and of their exact significance!

In connection with the plant, the problems are still more numerous and many-sided. There is an absolutely unlimited field before the plant breeders who seek to evolve improved varieties of all our cultivated crops. The colossal annual losses through plant diseases and insect pests are largely due to our lack of complete knowledge of the organisms concerned, and therefore of the best methods of attack on them. Weeds of various kinds enormously reduce the productivity of our agricultural and pastoral lands and here again practical remedies can only be discovered as the result of much patient investigation. The multifarious factors involved in connection with our most important crop—our natural and induced pastures—demand an immense amount of further investigation before the best methods of pasture improvement for any particular soil or district can be evolved. Horticulture bristles with problems which only the skilled plant physiologist has any hope of solving.

With regard to problems relating to the animal we confidently leave the pathological side in the hands of our veterinary friends. There are, however, many problems connected with animal nutrition which are the legitimate sphere of the agricultural scientist. The technique of manufacture and the improvement in quality of dairy products are other lines which must engage his constant attention. There are still many unsolved problems connected with the storage and transport of plant and animal products which urgently await solution. There is need for greater precision and accuracy in field and other experiments which call for the services of the biometrician. Certain important aspects of agricultural economics have been the part-time study of relatively few workers

in Australia whereas they ought to provide whole-time work for quite a large number of investigators. Notable improvements in farm implements have been a marked feature of the agricultural advance and there is still great need for further research by the man with a combination of agricultural and engineering knowledge. These are but a selection from the immense list of problems which could be enumerated. The potential harvest indeed is plenteous, but the skilled labourers in the diverse field of agricultural education and research are still relatively few.

But, you may ask, has not agricultural science advanced too rapidly? Have we not over-production with unprofitable prices as the result? A close analysis of the position would show quite clearly that under-consumption is the trouble of the world and not overproduction. Rising barriers to the freedom of exchange of goods and services constitute the main obstacle to the return of general prosperity. These are factors over which, unfortunately, the agricultural scientist has no control, and we must take the world as we find it—a world in which, for the time being, there are limited markets and the keenest competition for these markets. In that connection I should like to emphasise that agricultural science aims not so much at the production of an increasing bulk of commodities as at improving their quality and marketability, and at decreasing the cost of production.

Most of the problems in agricultural science are of a very complex nature requiring for their solution a knowledge of nearly every fundamental science and therefore the co-operation of several workers. It is pleasing to note an increase in the amount of team work of this kind within individual departments and even amongst separate organisations. If the Australian Institute of Agricultural Science does nothing more than foster this team spirit and facilitate co-operative efforts in research it will amply justify its existence and earn the gratitude of succeeding generations.

Roseworthy Diploma in Oenology

By Dr. A. R. Callaghan

Principal, Roseworthy Agricultural College.

For close on forty-five years Roseworthy Agricultural College has taught viticulture and wine-making; singularly enough no other institution in Australasia has given special and detailed instruction in wine-making, or to use its more aristocratic and classic name, oenology. At the opening of the new scholastic year in April an advanced course was inaugurated; this entails two years' study at the College and the final award of a diploma.

Australia produces on the average about 16,000,000 gallons of wine per annum; of this, South Australia contributes an average of over 12,250,000 gallons. Behind this production are the manufacturing wineries and distilleries, involving alone an enormous capital outlay and annual expenditure, as well as the viticultural interests which grow the grapes. The industry is unquestionably the main support of thousands of people in South Australia, where it takes a prideful place next to wool and wheat.

Of equal significance, especially from the Commonwealth viewpoint, is the steady growth of export in wines. Over 3,300,000 gallons are now exported annually from Australia, of which South Australia's contribution is nearly 2,750,000 gallons. The demand from the overseas markets which have already been served by Australian wines is still vigorous, and, provided full and proper attention is paid to quality, these markets should absorb increasing amounts of Australian wine. In addition new markets are available; that they need careful approach is admitted, but the potentialities are there, and their satisfaction must affect world supplies. There appears to be a large field open to exploitation in the East, especially for our brandies, and with the United States of America no longer "dry" we should acquaint them with our wines as a medium by which some, at least, of our trade account could be settled. Taking all things into consideration the wine export market presents an outlook better than most, and it is one which should go on expanding provided quality and details of distribution receive strict attention.

I have written sufficient to stress the importance of the industry. Obviously a specialised process needs trained men skilled in the art, and if the industry is to expand—as it should—the demand for skilled assistants will be greater. In the past, Roseworthy College has supplied the wine trade with men who, with the knowledge of apprentices, have gone out into the trade, many now controlling as managing proprietors the leading wineries of Australia. Latterly the demand has been constant for young men trained at the College who were anxious to enter the wine trade; but the insistence for men of more advanced training has never been met simply because of the absolute dearth of students who could claim to have had some advanced training. In the past three years, the College has continued the training of picked students as cadets, and in every case these more advanced trainees have been feverishly sought after and have received good starting appointments. The only alternative to the man anxious to gain further training was to go abroad, where a continental experience in wines was certainly possible, but where the details of local problems and local conditions peculiar to Australia were obviously neglected.

In South Australia last year there were 92 wineries or distilleries, employing in all 793 men. Of this number, 105 were working proprietors, managers or overseers. So that apart from the expansion which is taking place, there are 105 employed in wine making who can claim a full working knowledge of the

subject. This number, together with the prospects of continued expansion, offers a definite demand, and as these circumstances apply to South Australia alone it is reasonable to suppose that six students (the maximum number taken each year) leaving Roseworthy thoroughly trained will have no trouble in finding good employment in the trade.

The following are extracts from the tentative prospectus of the new course issued by the College last March.

Aims. The object of the course is to provide a thorough, theoretical and practical training in wine-making and allied arts. In this respect it is designed to supply the demand from all parts of Australia (a) for men fully qualified to supervise and control the manufacture and maturation of wine and by-products of the vine, and (b) men qualified to conduct analytical, bacteriological and yeast studies in commercial wineries.

The College will also aim to solve as many of the wine-makers' difficulties as possible by investigating all matters of direct practical significance to the trade, and especially where a knowledge of which would be essential to effective teaching.

Students completing the course and passing all examinations as set down in the regulations will be entitled to the academic distinction of Roseworthy Diploma in Oenology (R.D.Oen.).

Conditions of Admission. The course of training set out is of a technical and highly specialised character and students desirous of entering must have a sound educational background, a full and proper understanding of the fundaments underlying general agricultural and horticultural practice, as well as a thorough working knowledge of chemistry.

Students desirous of entering the course must have turned 18 years of age before the 1st April of the year of admission and must supply medical testimony that they are fit to undertake the work.

The number of students admitted each year shall be limited to six.

The following are the minimum qualifications which will be required for admission:

(a) Applicants holding an agricultural diploma from any duly constituted Agricultural College in Australia, or any University degree or diploma of relative significance shall be admitted to the special course of studies in Oenology.

(b) Any student of the Roseworthy Agricultural College who has successfully completed the first two years of the ordinary Diploma course provided, in the opinion of the Principal, such student is sufficiently well equipped to enter the advanced course in Oenology.

(c) Failing evidence being provided of the standard set out in (a) and (b) students would be required to pass a special examination, conducted by the College, in the following subjects: English, Mathematics, Chemistry, Physics, Agricultural Botany, Soils and Soil Modifications and Viticulture.

(d) Students anxious to do the special course, and who may not be fully qualified, may enter the College as ordinary students, accommodation permitting, and on completion of two years proceed to the first year of the Oenology course, subject to the approval of the Principal, in accordance with clause (b).

Syllabus.

1. During the first year the following subjects will be treated, details of which will be outlined in a special curriculum:—

Principles and Practice of Wine-making (including Cellars, Cooperage and Equipment).
Bacteriology (including a study of yeasts).
Wine, Brandy and Vinegar Analysis.
Practical Cellar work.

2. During the second year the following subjects will be treated, details of which will be outlined in a special curriculum:—
Principles and Practice of Wine-making (including Cellars, Cooperage and Equipment).
Bacteriology (including a study of yeasts).
Distillation, Vinegar and Brandy-Making.
By-products of Wine Manufacture.
Wine Economics.
Wine, Brandy and Vinegar Analysis.
Practical Cellar work.

3. During the two years of study educational visits will be made to leading wineries outside the College, and every opportunity will be taken to see all phases of the industry as practised in the State.

4. *Vintage Experience.* Before being granted the Roseworthy Diploma in Oenology, all students will be required to complete at least two seasons' vintage experience with some commercial firm approved by the College.

Following the issue of this prospectus many inquiries were received, but in most cases the qualifications for admission were much below those stipulated, in other cases the fee was the limiting factor. The South Australian Wine Association has provided a scholarship for £100 to students desirous of entering the course for the next three years. Nine qualified persons applied for the scholarship this year, which was very encouraging. Four students have already begun the course, three being old students of the College and one an old student of Hawkesbury College.

In the next few months the purchase of equipment and modernisation of the College winery will proceed, and equipment for advanced chemistry and microbiology sufficient for 12 students will be provided in the laboratory buildings. In this respect everything to make the instructional work comprehensive and complete has been promised by the Government, and I feel that the future and ultimate success of the course are already assured. From its success may Roseworthy College gain the wider and more complete Commonwealth prestige it expects !

Strength or Baking Quality of Wheat

ITS DETERMINATION BY BAKING TESTS

By Leonard S. Cayzer, M.Sc., B.Sc.Agr.
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The meaning of the word "strength" which is so frequently used in describing the baking quality of a wheat or flour, has always been the subject of debate. It is certain that the word originated in an attempt to describe the physical characteristics of a dough. Realising that a "strong" dough would generally produce a good loaf of bread, Humphries (1905) suggested as a definition of "strength"—"The capacity of a flour to make large well piled loaves." On this basis the flours which could produce the largest loaf of good texture would be the "strongest."

This definition has been accepted for many years, although Kent-Jones (1924) maintained that flours yielding doughs in which gas production was at a low level, should not be regarded as "weak," and suggested Humphries' original definition should be modified to read "strength is the ability of a flour to be converted into large well piled loaves, provided any deficiency in the rate of gas production in the dough is supplemented in a suitable manner."

There are other factors which must be considered, which greatly complicate the meaning and use of the word "strength." The quantity of water which may be absorbed by unit weight of flour in making a dough of required consistency is of importance; so also is the weight of bread which can be made from unit weight of flour; neither can we overlook the "handling quality" of the dough, or in other words, those physical properties which determine the manner in which it will respond to machine treatment.

In the attempt to describe in one word so many characteristics of a flour, it was inevitable that confusion would result, and consequently cereal chemists are now endeavouring so far as possible to allow the word "strength" as applied to wheat and flour, to fall into disuse. It can be partly replaced by the expressions "baking quality" and "potential baking quality" as suggested by Alcock (1934), but it must be realised that we cannot describe a wheat or flour in one word or phrase—we must pick out its various characteristics and describe them individually.

To avoid confusion, the expression "baking quality" must be used with caution. It is a relative term and as such should not be used without a reference to the method or conditions of baking. "Potential baking quality," being an absolute term, may however be used with less reserve. It is the ability of wheat or flour to give good baking results under severe conditions. The greater the "potential baking quality" of a flour, the more severe baking conditions it

will stand, and—under optimum conditions—the greater will be the volume of the loaf of bread. Flours of high "potential quality" have the ability to carry weak flours in a blend.

In the following hypothetical case, five baking procedures are used. Test No. 1, is the least severe, the severity of treatment increasing from (1) to (5). Suppose three flours "A" "B" and "C" which are to be placed in order of potential baking quality, are baked by all of the five procedures, with the following results:—

Loaf Volume (c.c.)

Sample	1 Malt	2 Malt Phosphate	3 Malt Bromate	4 Malt Phosphate Bromate	5 Malt Phosphate Bromate: 3 mins. Hobart-Swanson mixer
"A"	500	580	650	760	900
"B"	600	640	590	520	460
"C"	580	600	630	650	590

On these tests, flour "A" has the highest "potential baking quality," as it was able to withstand more severe treatment than the others, the largest loaf being given by the most severe treatment. Flour "C" would come next, and flour "B" would be classed as the poorest of the three. If now, instead of using all five baking tests, it had been decided that tests (1) and (2) most nearly corresponded to commercial conditions in this country and should accordingly be used to the exclusion of all others, quite different conclusions would be reached. In this case, however, the flours would be classified on a basis of baking quality according to conditions in this country, and flour "B" would be the most suitable, followed by "C" and "A." Which then is the best flour? It all depends upon the purpose for which they are intended, but from the standpoint of "potential baking quality," flour "A" is the best. Although under certain commercial conditions of baking, its potentiality will not be revealed, the fact remains that if the method be made more severe, whether by the use of more yeast, oxidising agents, or by a mechanical modification of the dough, it will produce larger loaves of better texture than the other flours under any conditions.

In trying to show the difference between "baking quality" and "potential baking quality" certain factors have been purposely negelcted. They are:—

1. *Water Absorption.*—In the above case, generally, flour "A" would have the highest water absorption of the three flours under test. It may well be asked: "Why, then, may water absorption not be used as a measure of potential baking quality, thus saving the trouble and expense of exhaustive

baking tests?" Water absorption has in fact been widely used, and for long was considered to be a reliable index to a flour's "strength." Although, however, there is a correlation between "potential baking quality" and water absorption, it is not sufficiently high to be of value for prediction purposes. Nevertheless, the importance of this aspect of a flour's behaviour must not be lost sight of, and it should be taken into consideration when judging baking quality.

2. *Handling Quality of the Dough.*—In addition to having the highest water absorption, flour "A" would in general yield a dough with the best handling quality. Once again, although this characteristic is of the greatest importance, it cannot be relied upon in classifying the flours on a basis of potential baking quality, unless the conclusions are supported by baking tests.

A baking test then is necessary—but what test or tests are to be used? Each chemist or baker has his own ideas on this subject, but only some of the better known baking procedures will be discussed. The baking test chosen will vary according to the information which is sought. The chemist may wish to determine potential baking quality or baking quality under some pre-determined conditions.

First, consider the baking test used by Dr. Kent-Jones, a test typical of the procedure adopted by many laboratories in England. Being an adaptation of commercial baking methods to laboratory practice, flours of high potential baking quality are penalised and do not give optimum results. If loaf volume were to be used as a criterion of "strength" in such a test, the results would be inaccurate and confusing. Knowing from experience that this is the case, Kent-Jones relies chiefly on the handling quality of the dough in deciding which flour is the "strongest." The assumption is of course that there is a high correlation between handling quality and what is known as "strength."

Generally, the best handling flours are those of highest potential baking quality, and using his baking test Kent-Jones is more likely to arrive at correct conclusions by considering handling quality, rather than loaf volume.

While admitting that fairly reliable conclusions may be reached by using a semi-commercial baking test, and judging the flours on the handling quality of the dough, the writer is nevertheless convinced that loaf volume measurements, using carefully selected and controlled standardised baking procedures, are the best indications of the potential baking quality of a flour. This method has the great advantage that the results are numerical and consequently better for recording purposes.

Having decided that loaf volume is to be the chief criterion of potential baking quality, it remains for the chemist to choose suitable baking procedures. What factors must be taken into consideration when the choice is being made?

1. The baking test should be one which will give the maximum range in loaf volume with various types of flours. This is important, because it has

been found that baking duplicate loaves on different days, the standard deviation of differences between duplicates, even with the most expert baker, is 15 cc. For a difference between means of duplicates to be significant therefore, it must be at least 30 ccs. (taking the 5% point of significance as sufficiently accurate for the purpose). Obviously, then, in order that mean loaf volumes might show significant differences, it is necessary that the range in loaf volume should be as wide as possible.

2. One baking procedure should be chosen which will bring out the maximum potentiality of the flour.

Referring to the foregoing table dealing with loaf volume, it will be seen that flour "A" only reached its maximum loaf volume with a very severe test. When baked by the same procedure, flour "B" gave a very much smaller loaf than with a less severe procedure. It would be obviously unfair to flour "A" to use procedures 1, 2 and 3 only, and it would be also unfair, though to a lesser extent, to flour "B" to use procedures 4 and 5 only. A compromise is necessary, and in general it is possible to arrive at quite satisfactory conclusions by the use of two, and sometimes three procedures. Two baking formulae have been evolved after much investigation and thought, and are now being used by the Associate Committee on Grain Research of the National Research Council of Canada. They are:

(a) Malt phosphate procedure.—The same formula and procedure as the basic method of the American Association of Cereal Chemists, except that a prescribed quantity of malt and 0.1 gram of ammonium phosphate ($NH_4H_2PO_4$) are added to the dough at time of mixing.

(b) Malt-phosphate-bromate.—Same as above, with 0.001 gram potassium bromate added at time of mixing.

The third procedure frequently used, combines the malt-phosphate-bromate procedure with an increased mixing period in a Hobart-Swanson dough mixer—generally a three minute period being used instead of one minute as set down in the basic method.

The object of using progressively severe methods of baking when testing a flour is to find—

(a) The most severe method of baking which the flour will stand without showing signs of damage to the loaf.

(b) The maximum loaf volume which can be produced, and the response in loaf volume to the various treatments.

The experienced technician may readily ascertain from the appearance of the loaves baked by different procedures, whether a flour has shown its full potentiality. With most flours, the malt-phosphate-bromate procedure is sufficiently severe, but flours of the hard red spring class with high protein content, frequently respond to the mechanical modification of the dough brought about in the Hobart-Swanson mixer. It has been found in Canada that this method

is the best single baking test in judging flours of higher than average potential baking quality. In sound wheats, there is a very high correlation between protein content and loaf volume as determined by this method. The method is, however, too severe for use with low quality flours, the range in loaf volume being narrowed rather than widened, as it is with high quality flours.

The malt-phosphate, and malt-phosphate-bromate tests are now being used with slight modifications in many parts of the world. In N.S.W. they have been found to be highly satisfactory, although some of the very early maturing high quality wheats require a double dosage of bromate to bring out their full potentiality.

Two examples are given below:—

Loaf Volume (c.c.)

Variety	Malt-phosphate	Malt-phosphate bromate	Malt-phosphate bromate*
Florence	475	545	665
Gular	500	565	680

*Double dose of potassium bromate

It is also certain that other varieties in the same class, such as Pusa 4, Ideal, Pusa III and S.H.J., would show marked responses to severe mixing in the Hobart-Swanson machine, and until such time as these wheats can be tested by this method, it will be difficult to satisfactorily classify them.

From the above discussion, the reader may imagine that the classification of wheats on a basis of potential baking quality would be easy. There are, however, other features of a flour's behaviour which must be considered, such as water absorption, handling quality of the dough, stability or resistance to flow, and—in the finished loaf—crust colour and general appearance and symmetry of the loaf, together with crumb texture, grain and colour.

In considering all these factors, it frequently becomes impossible to directly compare varieties and place them in a definite order of potential baking quality.

In conclusion, it is interesting to note that Blish and Sandstedt (1935) claim that protein content is the most reliable index of the potentiality of a wheat. While admitting that many wheats of high protein content are considered to be of low baking quality, these workers claim that a method of baking could ultimately be found which would reveal their full potentiality. This viewpoint is supported by a number of cereal chemists who claim that we shall find means of treating high protein, so-called low quality wheats either before or after milling, so as to improve greatly the quality of the protein and, accordingly, the baking quality. For the present, however, we must perforce rely upon baking tests.

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Periodical Adjustment of Farm Rentals

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Tenant farming, as practised extensively in Great Britain, is comparatively rare in Australia. In spite of this, many Australian farmers are no more than the nominal owners of their properties which commonly carry heavy mortgages. In addition, large numbers of holdings are under the control of Closer Settlement, Soldier Settlement and similar Government Departments of the various States. In effect, tenure under these conditions is comparable to the holding of land under rental from a landlord, and the following notes are equally applicable whether payments ensuring the continued occupancy of the land are made to mortgagee, Government Department or landlord.

Circumstances beyond the control of the farmer often determine or influence the yields which he will obtain. The occurrence of good and bad seasons, outbreaks of disease, and the ravages of pests cause fluctutations in the amount of his produce. Variations which occur from the causes enumerated above may be regarded as the everyday risks associated with the business of farming, and although they often have serious consequences, the probability of their occurrence can be foreseen and allowance made accordingly. But overshadowing the variations in farm income due to seasonal and associated conditions are the fluctuations which occur in the value of the produce when expressed in cash units. Index figures give a clear idea of the fluctuations in the value of farm products and disclose a position which by no stretch of imagination can be regarded as satisfactory. Examples can be quoted showing that during the past decade the monetary value of farm products has been more than three times greater at some periods than at others.

Without entering into a discussion upon such a controversial matter as the money system, we can all agree that it would be desirable for the real wealth represented by the produce of a farm to have a constant value in units

of exchange (money). Under our existing economy this does not appear to be possible, and consequently it is desirable to consider alternatives to the current practice of fixing the interest charges or rental of farms on a cash basis without regard to price fluctutations for the produce.

In particular the positions of soldier and closer settlement calls for serious consideration. In the light of the existing position and the events of the past few years, it is becoming increasingly apparent that a new policy will have to be formulated. The practice of granting concessions, suspending arrears and reducing rentals in necessitous cases does not meet the position.

Large numbers of settlers are urging a revaluation of their holdings, arrears are accumulating, and on the part of many settlers there is a feeling of hopelessness in consequence of a recognition of the fact that they can never meet their expenses and pay off accumulated arrears. The standard of living of many settlers and their families has fallen to a very low level. On the other hand, the granting of concessions has in some instances established precedents which are exploited by certain settlers who are in a position to do more than they actually do in meeting their commitments.

An outstanding reason for the present position is the lack of correlation between the prices received for farm products and the cost of producing same. The former fluctuate violently, the latter remain relatively constant. If farm costs, of which usually the greatest is rent or interest, can be made to move in sympathy with prices, the farm problem will be partly solved. Incidentally, fluctuation in the prices of primary produce offers the most potent reason against a revaluation of properties at the present time. If such a revaluation based on current prices is followed by a rise in prices it would result in the State meeting the losses of settlers in bad times without any opportunity to recoup in good times.

Under the existing capitalistic economy it is doubtful if a full solution of the problem is possible, but it is considered practicable to remove some of the anomalies. Bitter experience has shown the impracticability of basing the rental of farm properties on their alleged capital value without regard to the prices which will be realised for produce, and consequently the following alternative is suggested :

SURVEY

Each farm should be subjected to an agricultural survey and the following factors determined:

1. Its suitability for particular lines of production.
2. The ratio which should be observed between fertility-exhausting and fertility-restoring activities.
3. The amount of produce of various kinds which the holding can be expected to produce annually, due regard being paid to a satisfactory standard of

efficiency on the part of the occupier, to the maintenance of soil fertility, and to the incidence of seasonal fluctuations and other variables beyond the control of the farmer.

4. The value of the estimated production should be assessed on a determined basal price.
5. Fixed overhead charges such as rates, land tax and insurance should be determined and other "first charges" should be added. These should include depreciation, and a minimum living allowance for the settler. (This should be at a low figure only sufficient to provide necessities, as otherwise there will not remain sufficient incentive for full endeavour).

TENURE

Settlers should be granted an actual tenancy from year-to-year at an adjusted cash rental to be assessed as outlined below. The conditions of tenure should ensure the right of the tenant and his heir for renewals indefinitely, provided that a satisfactory farming standard is maintained, the fertility ratio is adhered to and the rent is paid.

ASSESSMENT OF RENTALS

The cash rental should be adjusted annually and should be based on the weighted index figure of the value of the kind and amount of produce for which the farm is adapted. It would be necessary for index figures to be prepared annually for all types of produce.

QUINQUENNIAL ADJUSTMENT

Every five years there should be an adjustment to make provision for fluctuating production costs and for the influence of developmental work carried out on the holding by advances from the State, mortgagee or landlord.

CASH RENTAL ASSESSMENT

It is suggested that the following formula should be adopted in determining the cash rental to be paid each year:—

$$R = Z\,(Aa + Bb + Cc \text{ ----}) - (S + Y)$$

Where	R	=	Cash Rental
	Z	=	Share factor.
A,B,C etc.		=	Basal price value of production of various kinds as determined by survey.
a,b,c, etc.		=	Price index factors.
	S	=	Fixed overheads (not to include rent of or interest mortgage on property).
	Y	=	Operating costs as determined by quinquennial survey.

The factor Z determines the proportion of the nett farm income to be paid by settler as rent or interest. It is the only factor which need call for arbitration or bargaining. (Nett farm income is the value of produce, based

on reasonable production and determined index factors, less fixed overheads (S) and less operating costs (Y)).

The factors a, b, c, etc., price index factors, are determined by taking the index figures for the particular products and expressing them in proportion to unity, e.g., if, relative to the base, the index figure for potatoes is 1,500, the index factor is 1.5.

The factor S should include land tax, rates, insurance, depreciation on fixed improvements, etc., and a minimum living allowance. The factor Y should include all essential farm operating costs as determined by survey—such items as manure, seeds, repairs to plant, etc. A quinquennial estimate of the value of Y should be made in order to provide for variations in the prices of secondary products used in primary production.

FERTILITY RATIO

Conditions of tenure should provide for the maintenance of a satisfactory relationship between farming activities leading to soil exhaustion and those resulting in fertility building. An important part of any farm survey is to fix this ratio. It can be done in the following manner.

For practical purposes cash crops can be regarded as exhaustive agents, and a unit-area scale such as the following adopted:

Potatoes	10	Exhaustive factors (E.F.)
Wheat	9	
Oats	6	
Barley	6	
Peas	2	
Hay	7	

Livestock and activities associated with their keep, can be regarded as restorative factors in somewhat the following proportion per head:

Milking cows	2.25	Restorative factors (R.F.)
Ewes	1.2	
Dry sheep	1	
Cattle:		
Calves	.8	
Yearlings	3.2	
2-yr.-olds	4.4	
Adults	5.6	
Pigs	1.2	

Conditions relating to farming methods should stipulate the value of the ratio:—

$$(Aa + Bb + Cc \text{ ----}) \quad : \quad (Mm + Nn + Pp \text{ ----}).$$

Where A,B,C etc. are the acreages of respective crops.
a,b,c, etc. are the exhaustive factors for those crops.
M,N,P etc. are the numbers of stock of various kinds.
m,n,p etc. are the restorative factors of stock.

The ratio will not be a constant one for all farms but should be fixed according to land quality as assessed at time of survey.

The adoption of such a plan does not necessitate the settler growing any defined area of any particular crop or carrying any number of a particular class of stock. It gives him the right of selection, but his total cropping should bear a defined relationship to his total stocking when expressed in E.F. and R.F. units.

Nominally, Closer and Soldier settlers are the owners, or expectant owners, of their holdings; in effect the majority of them are tenants of the State and are likely to remain as such. A frank recognition of this fact would do much to facilitate complete readjustments. It is suggested that the State should resume all holdings on which arrears exceed the advances and that other settlers should be given the opportunity of coming under the proposed method of control, on a voluntary basis.

Holdings which, when surveyed, are considered as likely to remain uneconomically sub-marginal should be devoted to forestry or allowed to revert to Crown Lands. Supra-marginal holdings should be brought under the proposed scheme and all arrears which have accumulated in spite of reasonable efforts on the part of a settler, should be written off.

The advantages of such a system to tenant or lessee are that he enjoys an increased measure of financial stability and can negotiate a long lease or period of tenancy which under ordinary circumstances he might hesitate to consider. Although the rent is adjusted in proportion to the prices of produce, there remains incentive for him to maintain a high standard of efficiency, for which he will reap the reward. Better farming methods are encouraged, and, as the farmer has a reasonable chance of meeting his obligations, his morale is kept at a high level. Together with the owner of the land, he shares in good times as well as bad, and he is not required to accept all the risks associated with falling prices.

On the other hand, the owner derives certain benefits. Should prices fall he has every chance of being paid the rental agreed upon because the farmer is not loaded beyond his capacity to pay. Should prices rise during the currency of a lease or tenancy, the owner reaps a benefit which he would not otherwise have obtained. Encouragement is given to better farming methods and the property is not so liable to deteriorate through lack of attention on the part of the occupier, or because soil fertility is exhausted through excessive cropping undertaken in an effort to get more out of the farm in order to meet a fixed rental.

The adoption of a scheme based on the above principles should not be difficult to introduce in connection with properties in which the States are financially interested. It should be equally beneficial if applied to private leases, and could also be extended to apply to interest charges on rural mortgages.

Some Principles of Statistics and Their Application to Agricultural Experiments—II.

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SIGNIFICANCE TESTS.

The simplest type of agricultural experiment would be one in which a direct comparison was to be made between two single effects, for example, between a pair of fertilizer treatments, or between two different varieties of a crop, or two methods of cultivation. Suppose, for instance, that the yielding abilities of two varieties of wheat are to be compared. Several plots will be grown of each variety, and then the difference in mean yields of the two varieties will be compared with the differences between the yields of different plots of the same variety. There will be some differences in yield between different plots due solely to uncontrollable causes such as the innate superiority of the soil in one plot over that in another. The variation between plots of the same variety affords a measure of this, and if the difference between the means of the two varieties is to be judged significant, it must be too great to be reasonably allowed for by these uncontrolled causes. With the aid of mathematics we can determine a numerical value for the variation due to uncontrollable causes, and, then, on the basis of certain assumptions which it is now proposed to investigate, can find the probability of getting two samples with means differing by as much as ours, from a population with estimated variability equal to the value which we have determined. If the probability is very small, then the two groups of observations cannot be regarded as a pair of random samples from the same population, and we say the difference between them is significant.

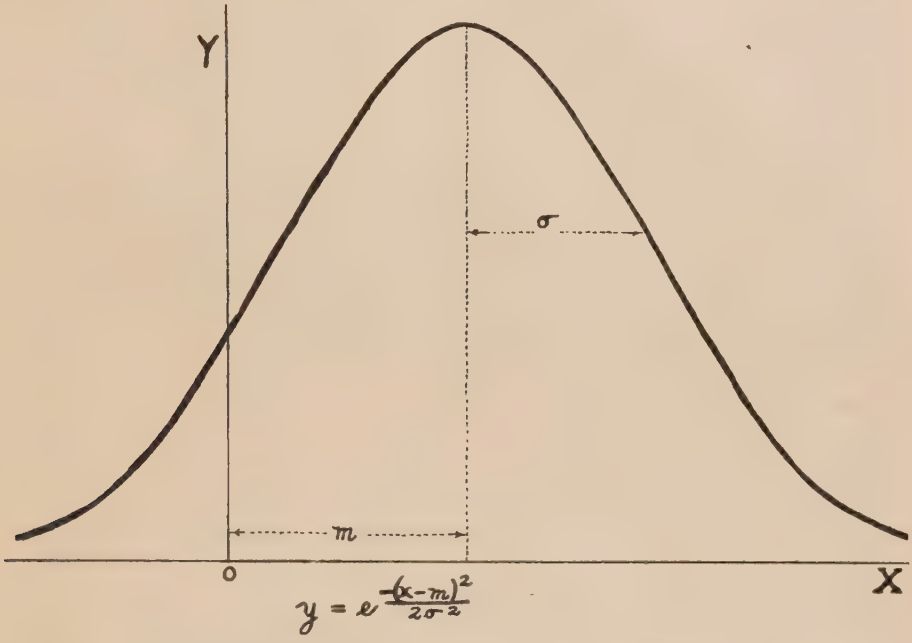
In order to follow the process, it will be necessary to return to a consideration of frequency distributions. In the last paper we considered two examples of frequency distributions. One of these was taken from a dice throwing experiment, and there the observations could be considered as a sample from a hypothetical population, whose mathematical law of distribution was exactly known before the experiment commenced. In the other a frequency distribution was found from a set of data on wheat yields, by counting the number of times the yield fell within certain class limits. As nothing definite is known about the causes at work, determining the values

of the yield, it is not possible to state beforehand any mathematical formula for the hypothetical distribution of yields. This is true of the data in nearly all biological investigations. For observations on a quantity which can vary continuously, such as yield, height, or weight, the graph of the hypothetical distribution, if it were known, would be a smooth curve. When only a few observations are made, the sample distribution is very irregular. But if there are enough data to give a reasonably smooth distribution, a knowledge of the mathematical equations to different types of curves, enables one to guess at likely forms for the hypothetical population.

It has been found experimentally that many sets of data fit fairly well to a particular curve, whose equation is $y=e^{-\frac{(x-m)^2}{2\sigma^2}}$. This type of curve is called a "normal curve". To the experimental worker, the name has no particular meaning, and is, in fact, misleading. x is the variable quantity measured, and the area under any portion of the curve gives the relative frequency of observations lying within the range on which the area stands. We can regard the whole range of values of x as divided up into an infinitely great number of intervals dx and the whole area under the curve as the sum of all the rectangles standing on these intervals. We have seen that the probability of getting an observation in a particular class when the class intervals were finite, was the ratio of $\frac{\text{area of rectangle in that class interval}}{\text{total area}}$, so now the probability of getting an observation in the range $x-\frac{1}{2}dx$ to $x+\frac{1}{2}dx$ is the area $y\,dx$ divided by the total area A, i.e. $\frac{1}{A}e^{-\frac{(x-m)^2}{2\sigma^2}}dx$. Theoretically, x can have any value between minus infinity and plus infinity. In practical work, physical considerations often limit the range. But the frequency of numerically large values, either positive or negative, is so small in the theoretical distribution that a normal curve can still fit such series of observations.

If a mathematical law such as this can be assumed, then it is possible to calculate the probability of getting an observation between any particular limits. A great deal of statistical theory, including most of the tests of significance, has been based on the assumption of a normal curve for the distribution of the hypothetical population. It has been demonstrated empirically by various workers that in many instances, even when the observations do not fit the normal curve very well, the tests depending on this hypothesis still hold good with a fair degree of accuracy.

The constants m and σ in the equation to the normal curve represent properties of the curve, as shown in the figure. m is the distance of the value of maximum frequency from the axis of y, and σ is the distance of the point of maximum slope from the ordinate through the highest point. It is apparent that the curve is symmetrical about this ordinate, and is asymptotic to the



x-axis in both directions. The area under the curve is $\sigma\sqrt{2\pi}$. σ is called the standard deviation, and its square, σ^2, is called the variance.

Since $y\,dx$ is the frequency of observations of magnitude approximately x, the average value of x is the sum of all such quantities as $x\,ydx$ divided by the total number of observations, which is A. Thus the mean$=\int\frac{x\,y\,d\,x}{A}$. In the normal curve this is found to be the same as the value with greatest frequency, that is, the mode. The curve will be tall and narrow if the variability is small, because then the observations will be clustered closely about the mean. The value of σ is usually taken as the measure of variability. If the variability is bigger, the curve is more spread out, and there is a greater probability of getting observations deviating widely from the mean. From a sample, the best estimate of σ is the square root of the sum of the squares of the differences of the observations from their estimated mean divided by one less than the number of observations. The best estimate of the mean is the average, or arithmetic mean of the observations. Thus if there are n observations $x_1, x_2 \ldots . x_n$, the estimate $\bar{x}$ of the mean m, is $\frac{x_1+x_2+\ldots . x_n}{n}$, and the estimate s, of the standard deviation σ, is $\sqrt{\frac{(x_1-\bar{x})^2+(x_2-\bar{x})^2+\ldots . (x_n-\bar{x})^2}{n-1}}$.

Neither of the estimates $\bar{x}$ and s would be exactly equal to the true hypothetical population values m and σ, but in the absence of any further information, they are the best estimates we can make. The larger the sample, that is to say, the more observations we have, the closer our estimates should be to the real values.

The normal curve with constants m and σ would give the probability of getting a single observation within any given range. But the mean of a series of observations would not have the same frequency distribution as the individual observations. From commonsense reasoning, one would expect less variation among a set of averages, than among a series of single readings, and it can be established mathematically, that if the individual observations are normally distributed, with standard deviation σ, then the means of samples of n observations will be normally distributed with standard deviation $\frac{\sigma}{\sqrt{n}}$. Hence we can find the probability of getting a mean of n observations in any given range, if we know the variability of the individual observations.

In an experiment laid out according to the Beavan Half-Drill Strip plan, the two varieties A and B lie in pairs side by side. Suppose there are n pairs and it is desired to test whether A and B differ in yielding ability. For an individual pair the difference (yield of A—yield of B) will not necessarily be zero. But in the long run, the average of these differences will tend to zero if there is no real difference between the varieties. We have to test whether the mean value of the n observed differences deviates significantly from zero. Let $x_1, x_2 \ldots . x_n$ represent the n differences. An estimate, s, of the standard deviation of the infinite population of yield differences is found by calculating

$$\bar{x} = \frac{S(x)}{n}$$

$$s = \sqrt{\frac{S(x-\bar{x})^2}{n-1}}$$

The estimate of the standard deviation of the population of means is $\frac{s}{\sqrt{n}}$. We can now find the probability of getting a deviation greater than x in this population of means. In such a test, allowance has to be made for the fact that s is only an estimate, and we do not know the real value of σ. The correct distribution for means, making this allowance, was found by Student, and his "t" test, in which $\frac{x}{s}\sqrt{n}$ is calculated, is now used for testing the significance of a mean x. A convenient table, for looking up t, to ascertain whether the mean is significant, has been prepared by Professor R. A. Fisher, and is published in his book "Statistical Methods for Research Workers".

If the plots of the two varieties have not been laid out in pairs, but have been spread at random through the field, a modification of the test must be used, depending on the distribution of differences. If two quite independent observations are made, one of a type which has a normal distribution with standard deviation σ_1, and the other with standard deviation σ_2, then the frequency distribution of differences between pairs of such observations is also a normal one, with standard deviation $\sqrt{\sigma_1^2+\sigma_2^2}$. This can be established mathematically by the theory of probability, from the equations to the normal curves. In our example, we would be concerned with differences between means. It is assumed that the standard deviations in the populations of A yields and B yields are the same. Let $x_1, x_2 \ldots . x_n$ be the yields of the A plots, and $x'_1 \ldots . x'_n$ the yields of the B plots. Then we calculate

$$\bar{x}=\frac{S(x)}{n}$$

$$\bar{x}'=\frac{S(x')}{n}$$

$$s=\sqrt{\frac{S(x-\bar{x})^2+S(x'-\bar{x}')^2}{2n-2}}$$

The value of s is thus a sort of pooled estimate from the two groups. If there had been n_1 A plots and n_2 B plots then the formula for s would have been

$$s=\sqrt{\frac{S(x-\bar{x})^2+S(x'-\bar{x}')^2}{n_1-1+n_2-1}}$$

If we make $n_1=n_2$, this reduces to the form above. The estimated standard deviation of each of the means for A and B is $\frac{s}{\sqrt{n}}$, and the standard deviation of their difference is $\sqrt{\frac{s^2}{n}+\frac{s^2}{n}}$, i.e., $s\sqrt{\frac{2}{n}}$. We therefore calculate $t=\frac{\bar{x}-\bar{x}'}{s}\sqrt{\frac{n}{2}}$ and look this up in the "t" table to see whether it is significant. In referring to the table, it is necessary to know the number of degrees of freedom available in making the estimate s. In the first illustration, where one mean only was calculated from the data, and there were n differences, the degrees of freedom were $n-1$. In the second illustration there were $2n$ observations contributing to the estimate, but the two calculated means $\bar{x}$ and $\bar{x}'$ were used, so the degrees of freedom were $2n-2$. Each of the two sets of yields has contributed $n-1$ degrees of freedom. The level of significance is fixed arbitrarily. If the probability of exceeding an observed deviation by pure chance is very small, then the deviation is considered significant. Sometimes a probability of 5/100 is used and sometimes 1/100. It is open to the experimenter to take which level he chooses. The latter provides a much more stringent test and is therefore to be preferred.

THE ANALYSIS OF VARIANCE.

So far in this paper we have considered only a very simple type of experiment, in which a comparison was to be made between two direct effects. The earlier work on significance tests was confined to such comparisons. But since the introduction by Professor Fisher of the technique known as the Analysis of Variance, the scope of agricultural experiments has been greatly extended. A whole set of means can be compared at once.

It has already been pointed out that if single observations have a standard deviation σ, then means of n such observations have a standard deviation $\frac{\sigma}{\sqrt{n}}$. The terms standard deviation and standard error are really synonymous, but it is usual to speak of the standard deviation of single observations, and the standard error of means. The variance is the square of the standard deviation, and in future we shall speak of variances rather than standard deviations or standard errors. It follows that the variance of the means of n observations is $\frac{1}{n}$ of the variance of single observations. Suppose we have a set of data consisting of p groups of k observations each. For example, if 10 plots each were grown of a crop under 5 different fertilizer treatments, the 50 plots being arranged in an entirely random order over the experimental area, then the data from this experiment would provide 5 groups of 10 observations each. Since the treatment would have been the same for all the 10 plots in any group, we can obtain a measure of field variation from each set of 10 observations. The estimate of the variance in any one group is the sum of the squares of the deviations of the observations from their mean, divided by the number of degrees of freedom, which is 9 (that is, one less than 10). The more degrees of freedom used in estimating a variance, the more reliable will be that estimate. We can use all 5 groups together to provide a better estimate of field variation. Since each group contributes 9 degrees of freedom, there will be 45 degrees of freedom altogether. Add together all the sums of squares of deviations of observations from their own group mean, and divide by the total number of degrees of freedom, 45. This gives the best estimate we can make of the variance of observations on plots treated alike.

If there were no real difference in the effects of the fertilizers, then the 5 treatment means would be 5 random samples of means of 10, and their variance should be $\frac{1}{10}$ of the variance of the single plots. We therefore find the estimate of variance based on 4 degrees of freedom (one less than 5) of these five treatment means, multiply this by 10, and compare the result with the estimate already found of the single plot variance. Fisher has shown that the ratio of two independent estimates of a variance based on known numbers of degrees of freedom, has a certain frequency distribution. From this he has calculated

the probabilities of getting values of the ratio greater than given amounts. If the probability of getting a value of the ratio greater than that observed is very small, then we conclude that the two estimates we have obtained are not independent estimates of the same variance, but that the treatments have had differing effects, and this has increased the variation between the treatment means. We then say the difference between the treatments is significant. In Fisher's table for this test, instead of the actual ratio, a quantity z, equal to half the natural logarithm of the ratio, is used, and it is therefore necessary to calculate this quantity before referring to the table. The quantity z has been used because its values vary more regularly than the values of the ratio, and the "z" distribution has also other important applications in statistics. A table has been published by P. C. Mahalanobis in the Indian Journal of Agricultural Science for December, 1932, in which the values of z have been converted back to ratios. Using this table removes the need for calculation of the value of z.

The names commonly given to the two estimates of variance are mean square for error to the single plot variance, and mean square for treatment to the estimate from the treatment mean. It is usual to calculate the ratio of the larger to the smaller mean square. It would very seldom happen that the treatment mean square would be appreciably below the error mean square. The tables are entered with n_1 for the number of degrees of freedom corresponding to the larger mean square, and n_2 the number corresponding to the smaller one.

The actual arithmetical labour of making these tests is shortened by the use of certain algebraic identities. For instance, if $x_1, x_2 \ldots x_n$ be a series of observations, and $\frac{x_1+x_2+\ldots x_n}{n}=\bar{x}$, then $S(x-\bar{x})^2 \equiv Sx^2-n\bar{x}^2$. It is therefore not necessary to calculate the actual deviations from the mean. Another identity enables us to express the results we have obtained in a concise form, known as the Analysis of Variance. Consider the general case, with p groups of k observations each, of which the fertilizer trial was an illustration. Let x_r be any one of the k observations in the rth group, and $\bar{x}_r$ the mean of the k observations in that group. Let $\bar{x}$ be the mean of all the pk observations. The sum of squares in the error term was $SS(x_r-x_r)^2$, where the double summation denotes the fact that the squares are summed first within a group, and then the sums for all the p groups added together. The sum of squares in the treatment term was $S(\bar{x}_r-\bar{x})^2$ where the summation extends over the p treatment values. It can be shown that, if we were to disregard the grouping, and find the sum of the squares of the pk deviations of the observations from the mean of them all, then we should find $S(x-x)^2 \equiv SS(x_r-\bar{x}_r)^2+kS(\bar{x}_r-\bar{x})^2$. If the observations were ungrouped, the estimate of variance from the total set of observations would be obtained by dividing $S(x-\bar{x})^2$ by the total degrees

of freedom, which is $pk-1$. But $pk-1=p(k-1)+p-1$. So the total degrees of freedom as well as the total sum of squares can be divided into two parts. The quotients of the corresponding parts are the two estimates of variance we have found. We write this in the following tabular form :

Variance Corresponding to	Degrees of Freedom.	Sum of Squares.	Mean Square or Variance.
Treatment	$p-1$	$kS(\bar{x}_r-x)^2$	$\frac{kS(\bar{x}_r-x)^2}{p-1}$
Error	$p(k-1)$	$SS(x_r-\bar{x}_r)^2$	$\frac{SS(x_r-\bar{x}_r)^2}{p(k-1)}$
Total	$pk-1$	$S(x-\bar{x})^2$	

So the error term is a quotient of remainders, after the treatment terms have been subtracted from the total values. In our example, $p-1=4$; $p(k-1)=45$; and $pk-1=49$. The principle involved in this simple analysis can be extended to more complex systems of grouping. There can be a cross classification, such that, besides having p groups of k, there are also k groups of p. Then each of the p groups contains one observation from each of the k groups, and vice versa. In the analysis of variance a term will be included to allow for the k groups also. The error mean square is the variance in a population freed from major variations due to differences between groups, and we find it as a quotient of remainders after subtracting both lots of group terms from the total ones.

In the field experiments described, it was essential that the treatments should be distributed at random, so that we could legitimately assume that the different estimates of variance were true random samples of the hypothetical population. Modifications of this random arrangement are permissible, corresponding to different methods of grouping, and advantage can be taken of this to overcome some of the major variations in the different plots of soil constituting an experimental area. It is generally found that contiguous plots are more alike than distant ones. A good arrangement is therefore obtained in the following way : Divide the land into as many blocks as there are to be plots of each treatment. Then divide each block into as many plots as there are treatments. Put one plot of each treatment in each block, the position of the treatments in each block being arranged at random. The blocks and the treatments then provide the two sets of groups in the cross classification. This plan is known as a Randomized Block layout. The Latin Square plan is one in which allowance is made for field variation in two directions, and a triple system of grouping is involved. It is not possible here to enlarge on the many elaborations of these two plans, and a number of good articles have already been published on this subject, of which Fisher and Wishart (1930), Hoblyn (1931), Yates (1933 and 1935), Fisher and Yates (1934) are to be specially recommended. The first two of these give practical numerical

illustrations, which are very helpful ; for the same reason Professor Snedecor's book " Analysis of Variance and Covariance " is also valuable. The two papers by Yates deal mainly with the more complex types of experiment, in which it is desired to test the effect of a number of interacting factors, such as several quantities of one fertilizer applied with varying quantities of another manure, or the differential effect of varying amounts of fertilizer on different varieties of a crop. Such experiments are also described in detail by R. A. Fisher in his book " Design of Experiments " (1935). A brief outline of the developments in complex experimentation was given by F. C. McCleery in an earlier issue of this journal (1935).

All the illustrations used in this article have been purely agricultural. But the same methods, and the theory underlying them, apply equally to all experiments in which differences are to be tested between groups of observations.

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Technical Notes

AN EPIPHYTOTIC OF ERGOT IN PASPALUM IN NEW SOUTH WALES.

The widespread occurrence of ergot (*Claviceps paspali*) in paspalum throughout all coastal areas in New South Wales during the past summer was of intense interest to plant pathologists as well as to many other members of the community. Dairymen, stockowners, seed collectors and distributors, shire and municipal engineers and dry-cleaners all viewed the occurrence with varying degrees of apprehension or gratification, according to their vocational interests.

Paspalum dilatatum covers many thousands of acres in the coastal belt of N.S.W., in many cases to the complete exclusion of other grasses, so that it forms a dense sward of the one species. It is prominent on roadsides and is regarded as an undesirable invader of footpaths, lawns and golf courses in those areas where other grasses only under careful management are able to resist its encroachment.

In addition to the widespread development of the disease in coastal areas, it was observed also on paspalum growing on the banks of channels in the Murrumbidgee Irrigation Area. Water couch (*P. distichum*) grows extensively in low lying areas in North Coastal districts and was severely affected by the disease. It was observed also on *P. urvillei.*

Ergot in paspalum has been recorded in the United States, Argentine, South Africa and New Zealand, but until the spring of last year there were no definite records of its occurrence in Australia. It has since been ascertained that a sticky condition in paspalum had been noticed in portions of our North Coastal areas in past years, and it is obvious that the widespread occurrence of the disease during the past season only could have resulted from many independent centres of infection which originated from sclerotia developed in the previous season. A similar situation also occurred in Queensland, as Morwood (Queensland Agr. Jour. 44: 146-147, 1936) also reports extensive development of the disease in coastal areas of that State during the past season.

Brown (Jour. Agr. Res. 7: 401-405, 1916) has published an account of the life history of the causal fungus, but it is apparent that certain aspects of the disease have yet to be elucidated, and it may be somewhat premature to attempt a correlation of the epiphytotic with variations from the normal in the climatic conditions experienced last year in coastal areas of N.S.W.

In the first place, however, it might be indicated that common ergot (*Claviceps purpurea*) has been recorded on 15 species of grasses and small grains in N.S.W. since 1896 and although rye grass seed containing small quantities of ergot is frequently sown in North Coastal areas, there have been but few reports of ergot from these areas in the past. It is considered that climatic

conditions are such that normally development of stromata and production of ascospores occur for the most part prior to the development of the flowering stage of the host plants; inoculum is thus not available in quantity to cause widespread initial infection.

Seed production in paspalum for the most part is completed by the end of April, and at the present time most of the sclerotia formed during the summer already have fallen to the ground. It is presumed that ergot development in the 1934-35 season was completed also by the close of summer, and data in respect of the climatic conditions since that time have been examined.

The records for the coastal belt of N.S.W. last year indicate that the rainfall was below the average from April to August, although in the North Coast the July rainfall was slightly in excess of the average. Abnormally dry periods were thus experienced during the winter months with marked effect on

ABSTRACT OF METEOROLOGICAL OBSERVATIONS, SYDNEY, 1935-1936.

	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.
RAINFALL:										
Total (inches)	2.07	4.82	1.52	0.22	2.16	3.48	2.14	4.70	4.48	5.05
Departure from normal	-3.09	+0.10	-3.38	-2.68	-0.76	+0.62	-0.71	+1.77	+0.91	+0.80
No. of days	11	12	13	3	14	13	8	18	16	16
Average No. days rain (77 years)	14	13	12	11	12	12	12	13	14	13
DEW:										
Days observed	8	9	13	14	8	8	8	9	9	5
EVAPORATION:										
Total (inches)	2.458	1.969	2.037	2.909	3.035	4.080	5.385	4.958	5.233	3.947
Departure from normal	+0.639	+0.535	+0.515	+0.978	+0.323	+0.183	+0.772	-0.444	-0.153	-0.301
SHADE TEMPERATURE:										
Mean Max. (Deg. Fahr.)	66.8	62.6	62.5	66.3	66	72.8	73.3	74.4	75.8	75.1
Departure from normal	+1.2	+1.4	+2.7	+3.5	-1.0	+1.5	-1.0	-2.6	-2.6	-2.6
Mean (Max. & Min.)	58.4	54.3	54.1	56.9	57.8	64.6	66	68.6	70.6	69.8
Departure from normal	-0.5	-0.4	+1.2	+1.7	-1.4	+1.0	-0.9	-1.3	-1.0	-1.5

the annual totals as exemplified in the records for Sydney for which the figures were 30.97 inches, representing a deficit of 16.57 inches when compared with the average for the past 77 years.

Rainfall much in excess of the monthly averages occurred in the North Coastal sections last September and in the South Coastal sections in the following month, and it is suggested that these conditions were responsible for widespread production of ascospores with resultant infection in paspalum. Furthermore, on account of the dry winter, the early flowering stalks were shorter than usual, and the ascospores may have had more ready access to spikelets thus produced at levels somewhat lower than normal.

The disease reached its full development first on the North Coast and subsequently in the Central and Southern Coastal Sections. Conditions in the spring and early summer enabled it to develop so extensively that 100 per cent.

infections were observed in many areas from December, 1935, until the flowering periods terminated several months later.

By courtesy of the N.S.W. Divisional Meteorologist, abstracts of the monthly meteorological observations at Sydney were made available, and it is possible that the records and the variations from the normal indicated in the figures of the accompanying table may be of significance in relation to the development of the disease.

It will be seen that, on the whole, summer conditions at Sydney were abnormally moist and cool, the monthly rainfall averages and the number of days on which rain fell were in excess of the normal, whereas average temperatures and evaporation were lower than normal. An examination of the climatological data in respect of daily or weekly periods may reveal features which would prove to be of special significance, but even from the data presented it may be stated that conditions were such as to result in the presence of films of moisture on the young paspalum seed-heads at frequent intervals during the months of December, January and February when the disease reached its full development in the metropolitan area.

Plants frequently were seen in the early morning before dew had disappeared, with globules of the honey dew, creamy white in colour because of the presence of large numbers of germinating conidia. Insects occasionally were seen on the spikelets when the sphacelial stages were well developed, but they were not observed in any large numbers, and it is thought that wind and rain were more important agencies in the distribution of conidia. Saprophytic fungi soon appeared in the honey dew and the dark brown and black encrustations on the spikelets superficially resembled the widespread development of Sooty Head in Parramatta grass (*Sporobolus indicus*) caused by *Helminthosporium ravenelii*.

Enormous numbers of ergots were formed during the season, literally tons of sclerotia are now resting on the surface of the soil in coastal areas of this State, and it remains to be seen whether the increased amounts of potential inoculum will be of any real significance next season; as in the case of so many other plant diseases, however, climatological factors no doubt will prove to be of paramount importance.

Other features of the 1935-36 epiphytotic were as reported elsewhere. There were but few authentic cases of illness in stock attributable to the ingestion of ergots under natural conditions during the early summer months but more were reported as the ergots matured. It was found that the ergots could be readily separated by seed cleaning machinery, but London analyses indicated that the alkaloid content of the sclerotia calculated as ergotoxine was not more than 0.01 per cent., whereas a good commercial sample of common ergot may contain .2 per cent. The paspalum material was considered of no value for drug manufacturing purposes.

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NON-REPLICATED FACTORIAL EXPERIMENTS.

Owing to the stimulus given by the Statistical Department at Rothamsted, the development of agricultural research, particularly in the branch of field experimentation, has made rapid progress during the last decade. Outstanding among the various accomplishments of this department have been the researches on the factorial design of field experiments and the artifice of confounding as a means of controlling soil heterogeneity. These experimental devices have been the subject of a full and able treatment in a number of well-known papers by R. A. Fisher, F. Yates and others; it would be redundant therefore to attempt in this note any discussion of the advantages which accrue from their use.

It is in the large factorial experiment that the confounding of unimportant high-order interactions is most usefully employed, since the sacrifice of information on the comparisons involved is of little consequence. The evidence, accumulated from the analyses of experiments conducted at the Waite Institute, has shown that—as in the Rothamsted work—the high-order interactions have been, in general, of the same magnitude as experimental error. This fact suggested that these interactions might be exploited, not only for the purpose of confounding, but also as a means of providing an estimate of error in circumstances where it may be desirable to dispense with replication. In a factorial experiment of the type considered a single set of all combinations of factors will usually provide sufficient replication *within the set* to give an accurate determination of the main effects. For example, if it were desired to test three varieties of wheat at three levels of nitrogen and three levels of phosphorus, one replication of all combinations of these factors would require 27 plots. All plots contribute to the answering of every question and, therefore, the main effects will be measured with the accuracy appropriate to means of 9 plots.

If only one complete replication is employed all the independent comparisons, which the experiment provides, will be assigned to the effects of variety, phosphorus and nitrogen, together with their interactions, there being none attributable to pure error. Under these conditions the allocation of the degrees of freedom will be as follows:

	Degrees freedom
V	2
P	2
N	2
N × P	4
N × V	4
P × V	4
N × P × V	8
	26

The 8 degrees of freedom for the interaction N × P × V may be used as a basis for testing the significance of the main effects and of the first-order interactions, and if the latter proved to be insignificant they may legitimately be pooled with the second-order interaction to provide the estimate of error.

An improvement in the design may be effected by dividing the 27 plots into 3 blocks of 9 plots and making a suitable selection of the treatment comparisons, corresponding to one pair of degrees of freedom for the interaction N × P × V, to occupy the blocks. The experiment thereby gains the advantage of the greater precision of the smaller blocks through the sacrifice of an unimportant differential reaction. This results in the following partitioning of the degrees of freedom.

	Degrees freedom
Blocks	2
V	2
N	2
P	2
N × P	4
N × V	4
P × V	4
N × P × V	6
	26

As before, the error is estimated from the unconfounded interactions.

An experiment of this type was conducted at the Waite Institute during 1935; 3 varieties of wheat were used with 3 levels of nitrogen and 3 levels of phosphorus. The experiment consisted of two replications of the 27 treatments, each set of 27 plots being divided into 3 randomised sub-blocks to confound the same pair of degrees of freedom for second-order interaction in each main block. The objective was to observe the agreement of the results of each set of 27 plots, and to provide a check on the magnitude of the interactions from an analysis of all 54 plots, in which pure error degrees of freedom were available. Table I gives the analysis of variance of plots 28-54.

Since the fertilisers were applied in equal increments, the several effects have been partitioned, by utilising the orthogonal polynomials devised by Fisher (1), into their orthogonal components which correspond to the physical characters of the response curves.

In Table II are shown the standard deviations of a single plot calculated by the various methods and expressed as percentages of the corresponding mean yields. It will be observed that the agreement is good and that the interactions are, in fact, negligible in comparison with pure error.

The standard deviation of a mean of 9 plots, derived from the analyses of the sets of 27 plots is, in both cases, approximately 1 bush./acre and therefore the experiment is very accurate when consideration is taken of its size.

TABLE I.

Analysis of Variance (lbs. grain per plot)

Variation due to	Deg. freedom		Sum. Sq.		Mean Sq.	S.D.
Blocks	2		84.57			
N lin. regr.†	1		99.17			
N quad. regr.*	1		6.86			
P lin. regr.	1		595.13			
P quad. regr.	1		9.80			
V	2		799 23			
N lin. regr. × P lin. regr.	1		5.67			
N lin. regr. × P quad. regr.	1		8.27			
N quad. regr. × P lin. regr.	1		45.00			
N quad. regr. × P quad. regr.	1		0.36			
V × N lin. regr.	2	18	17.44	219.36	12.1875	3.4911
V × N quad. regr.	2		16.59			
V × P lin. regr.	2		20.31			
V × P quad. regr.	2		29.04			
N × P × V	6		76.68		12.7801	3.5749
Total	26		1814.12			

†linear regression *quadratic regression

TABLE II.

Estimates of Error

	General mean yield bush. per acr	Error estimated from—					
		2nd order interaction 6 deg. freed.		Pooled interaction 18 deg. freed.		Pure Error 24 deg. freed.	
		S.D. of a single plot bush. per acre	% of general mean	S.D. of a single plot bush. per acre	% of general mean	S.D. of a single plot bush. per acre.	% of general mean
Plots 1-27	46.67	2.84	6.09	3.02	6.46	—	—
„ 28-54	49.54	2.98	6.01	2.91	5.87	—	—
„ 1-54	48.11	—	—	—	—	3.14	6.5

It should be borne in mind, however, that such an experiment is liable to failure in the sense that the error of the comparisons may be overestimated, since it may happen that the interactions employed as error represent real effects, whereas the true error will be smaller. The experiment should be tried only in circumstances where there is evidence that the interactions would be too small to be statistically significant, due consideration being given to the size of the experiment proposed. It is worth noting that an indication of the presence of large high-order interaction effects may be obtained from the magnitudes of the interactions between pairs of factors; if any one of these were large, it would be worth while examining the three factor interactions involving this pair. Those which prove to be of considerable magnitude should be isolated from error.

The following elaboration of the design illustrated is of especial value in an experimental programme designed to investigate the manurial requirements

of a representative selection of varieties of a particular crop, as influenced by the simultaneous action of soil and climatic conditions. If four sites of the same general soil type are chosen within a district, and 27 plots used at each centre, it would be possible, by confounding a different pair of degrees of freedom at each place, to provide a wide inductive basis to any conclusions which may be drawn from the data.

The procedure illustrated is applicable with appropriate modifications, to other treatment systems, e.g., a 2 x 2 x 2 x 2 x 2. In certain circumstances, for example at various farms associated with a central experimental station, facilities for the convenient handling of more than approximately 30 plots are not usually available. Under such limiting conditions a single replication of a factorial system of treatments makes the most efficient use of the means at the disposal of the experimenter.

It should be emphasised, however, that the type of experiment described does not provide a means of dispensing with absolute replication on all occasions.

In concluding, it should be stated that the utility of non-replicated factorial designs has been known at Rothamsted for some time (F. Yates (2)), but was discovered independently at the Waite Institute in 1935.

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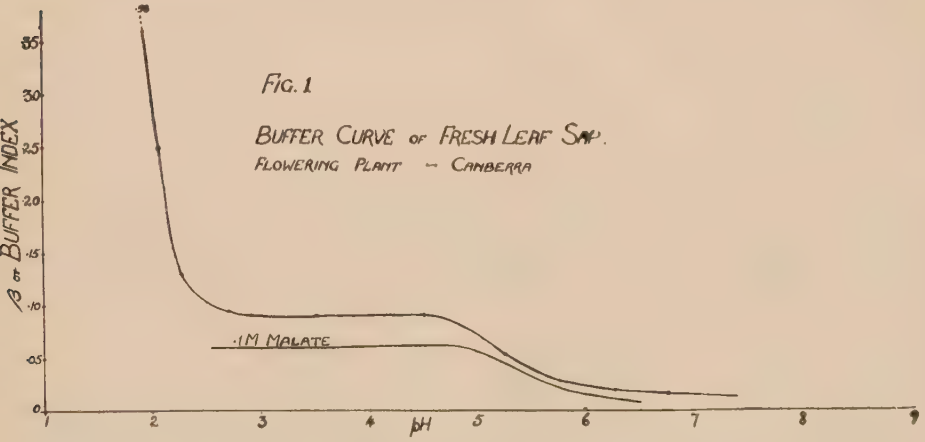
HYDROGEN ION PHENOMENA IN TOBACCO.

An examination was made of fresh leaves and flue-cured leaf of tobacco grown under various conditions, to ascertain the variation in their buffer curves.

Fresh Material.—The juice was expressed from the leaves of a flowering plant of *Nicotiana tabacum* which was growing in the green houses at Canberra. The juice was centrifuged and then decanted. The buffer curve obtained is shown in fig. 1. In the same figure there is a buffer curve for a .1 molar solution of malate and it is interesting to note the close parallel between part of the juice curve and that for malate. The increase in buffering below pH 2.5 is probably due to citrate and oxalate.

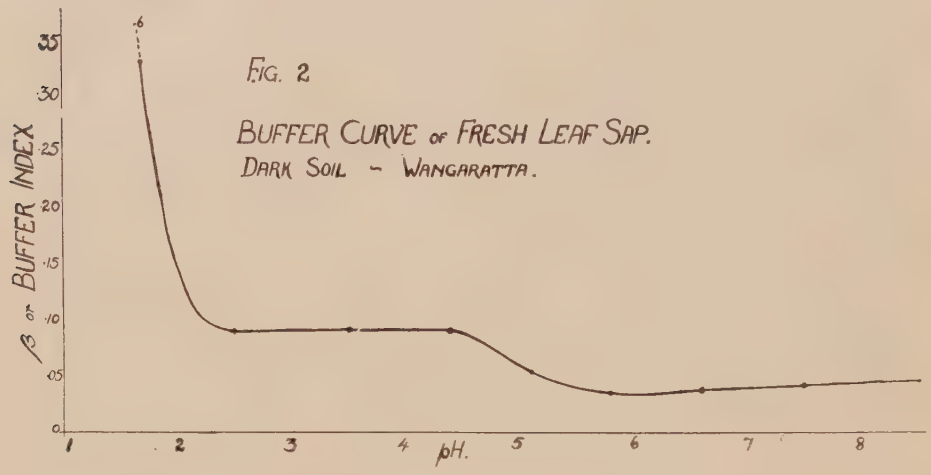
Following this, fresh leaf material was received in a chilled condition from Wangaratta, Victoria. In this instance, the leaves were minced and the sap expressed at 10,000 lbs. per sq. in., centrifuged and decanted. The curve obtained is shown in fig. 2, and is essentially the same as fig. 1 with the

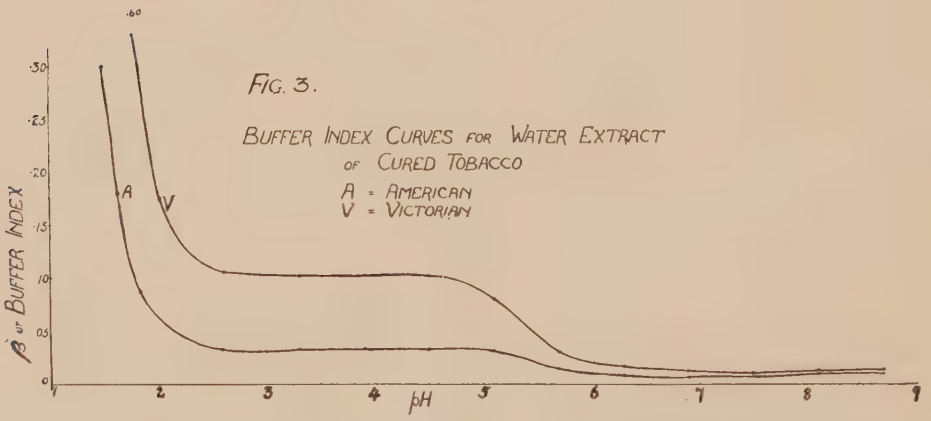


exception that there is an increase in buffering capacity beyond pH 7 which is probably due to phosphate. This material was collected from dark, river-flat soil. A sample of leaf material was also obtained from a sandy soil near Wangaratta. There was not sufficient of this material to enable a complete buffer curve to be obtained. It was noticeable, however, that the buffering was reduced throughout the range pH 2.5 to 5.

Flue-Cured Leaf.—Two samples of dried flue-cured leaf, one first quality American and the other Victorian, were ground to powder in a coffee mill. To a weighed quantity of each, sufficient water was added to bring the water content approximately up to that of fresh leaf material. The two flasks

containing these samples were placed on a sand bath and extraction allowed to proceed for several days. The extract obtained from each flask was treated in the same way as the expressed juice from the fresh material. The buffer curves obtained are shown in fig. 3.





It is interesting to see the increased buffering over the whole pH range in the Victorian leaf as against the American, and also to note the remarkable similarity in the curves for the Victorian fresh material and the cured leaf.

The observed differences in the degree of buffering indicate differences in amount of the organic acids present.

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CANBERRA BRANCH

At a meeting of the Branch held in the Canberra Hotel on Thursday, April 23rd, the Secretary-Treasurer, Mr. J. R. A. McMillan, presented an annual report and an audited statement of the accounts. Then followed an address by Dr. B. T. Dickson, President of the Branch, on "The aims and development of the Institute." He sketched the origin and development of the Canadian Society of Technical Agriculturalists and outlined the type and usefulness of the several activities of that body. Comparing the aims of the Institute with those of the B.M.A. and the Institution of Engineers, he showed that the Institute could only be held in esteem by the community in so far as it rendered service to that community. "Our main objects," he said, "are the promotion of the advancement of scientific agriculture, of a national policy of agricultural research and of the welfare of the professon, and the raising of the status of the profession in the community."

NEW SOUTH WALES BRANCH

The fifth meeting of the Branch was held at Science House on April 17 when there was an attendance of 23 members and 19 visitors (members of the Flour Millowners' Assoc. of N.S.W., present by invitation). The President, Dr. R. J. Noble, occupied the chair The minutes of the first annual general meeting were read and confirmed. The financial statement showed a credit balance of £19/4/8.

The main business was an address by Mr. L. S. Cayzer, M.Sc., B.Sc.Agr., entitled: "Recent Progress in Cereal Chemistry," an expanded account of which appears elsewhere in this issue. The address was followed by an interesting discussion in which members of the Millowners' Assoc. took an active part.

VICTORIAN BRANCH

The first meeting of the Victorian Branch for 1936 was held on the 3rd April when "The Relationship between Agricultural Research and Extension Work in Victoria" was discussed. Thirty-four members were present, the President, Professor Wadham, occupying the chair. Leading the discussion, Mr. W. B. Miller referred to the difficulties experienced in the United States of America and other countries, in co-ordinating research and extension work. The scope of agricultural research (including both pure research and experimental investigations) and of extension work had widened considerably in recent years. It was now necessary, not only to ensure that research work was not curtailed or impeded by the requirements of extension work, but also to organise in such a way that officers engaged in extension duties would have adequate knowledge of the activities and findings of the research workers. In some branches, it was advisable for officers to combine both research and extension work, but this policy, if carried too far, would adversely affect the success of each phase. Sound research and investigation furnished the basis of all successful extension programmes, but the monetary value of agricultural research was largely determined by the extent to which the findings of the workers

were put into practice by farmers and others handling primary produce. It was most desirable, therefore, that leaders of extension work should have the same fundamental training as research workers, so that the oft-referred-to "divergence in outlook" between the two, would not exist.

Various systems of extension work were discussed, particularly the district officer system which has not been applied in the comparatively small State of Victoria. The discussion indicated some divergence of opinion as to the relative needs of research and extension work. The general view favoured the further development of the present system of providing for close co-operation between research and extension workers on particular crops or problems rather than on the formation of an entirely separate, general extension service.

Re the admission of non-graduates.

The Victorian Branch is of the opinion that Article 5, Clause (a), Section 4, should be amended and that provision be made to admit non-graduates after examination by a carefully appointed qualifications committee.

SOUTH AUSTRALIAN BRANCH

The second annual general meeting of the South Australian Branch was held at the rooms of the Australian Chemical Institute, 74 Pirie Street, Adelaide, on 26th March, 1936, at 8 p.m. The attendance was 29, including 25 corporate members. Apologies for absence were received from Mr. W. J. Spafford and Dr. A. R. Callaghan. The Secretary's Annual Report and the Treasurer's Financial Statement for the year ended 29/2/36 were submitted to the meeting and adopted.

All office-bearers who had held office for the previous year were re-elected as follows: President, Professor J. A. Prescott; Hon. Secretary, Mr. C. M. Donald; Hon. Treasurer, Mr. C. S. Piper; Hon. Sub-Editor, Mr. H. C. Trumble; Additional Committee, Dr. A. R. Callaghan, Mr. W. J. Spafford, Mr. A. G. Strickland; Delegates to Federal Council, Dr. A. R. Callaghan, Mr. H. C. Trumble.

Dr. J. Davidson was provisionally elected a delegate to the Federal Council, to hold office if and when corporate membership of the Branch attained 50 prior to the 28th February, 1937.

An outline of the progress of the Institute was given by the Federal President (Professor A. E. V. Richardson). Corporate membership, originally anticipated at 150, had attained 285, exclusive of 23 student members, by the end of 1935. Branches had been formed in all States. The financial position had proved materially stronger than had been forecast, so that after all expenses had been met, a liberal refund was made to all State branches, leaving a useful surplus on hand. A tribute was made to the uniformly high quality of the four issues of Journal during 1935 and to the diligence and efficiency of the Federal Secretary during the difficult nascent year.

Two addresses were given, the first by Mr. H. B. D. Barlow, Senior Dairy Instructor of the South Australian Department of Agriculture, on the Dairy Industry of South Australia. Mr. Barlow stated that conditions in South Australia were not well suited for dairying. The area of country in which fertile soils coincide with liberal rainfall was severely limited and the dry summers normally experienced provided a disability not ordinarily met with in first-class dairying districts. The industry in South Australia was worth approximately £2,000,000 per annum (pig products included) and was comparable in value to the wine industry but supplied cash to considerably more people. The outstanding disabilities of the industry in South Australa were: (a) Lack of the co-operative principle in dairy manufacture; (b) Lack of areas of high rainfall and fertile soils

necessary for good dairying; (c) Existence of few definite dairy zones, where dairying was the main line of activity; (d) The difference in price between varying grades of butter in London, namely ¼d. to ½d. per lb. between choice and second-grade butter at the present time, was insufficient to encourage the production of a higher quality product at increased cost; and (e) Lack of suitable legislation empowering strict supervision of dairies.

Mr. R. C. Scott, Supervisor of Experimental Work in the S.A. Department of Agriculture, followed with an address on the Dairy Industry of New Zealand. Advertiser Newspapers Ltd. (Adelaide) had been instrumental in organising a party of South Australian farmers, led by Mr. Scott, which recently visited New Zealand for the purpose of gaining knowledge regarding livestock production in that country. Mr. Scott stated that in New Zealand pastoral products accounted for 92 per cent. of the total exports, of which dairy products comprised 45 per cent. Butter exports were valued at £11-12 million, with frozen meat, wool and cheese lower. Sixty-seven per cent. of the cheese and 28% of the butter imported by England were New Zealand exports. Dairying was conducted chiefly in the North Island, where the rainfall of much fertile land was between 30 and 60 inches, and was well distributed. Seeded pastures of perennial rye-grass, cocksfoot and white clover were common in dairying districts. Three cwt. per acre of superphosphate was the normal yearly fertiliser dressing, but as much as 8 cwt. per acre was sometimes used. Rotational grazing was customary. Jersey cattle constituted the majority of the herds, being favoured for smallness, high butter fat content of the milk and early maturity. Milk and cream were uniformly marketed on the basis of butter fat content, which had brought 9 to 10 pence per pound over the last three years. Boneless veal had become an important export product since 1927. Practically all dairying in New Zealand, Mr. Scott continued, was conducted on a co-operative basis, in contra-distinction to that of South Australia, which was mainly proprietary.

QUEENSLAND BRANCH

The Annual Meeting of the Branch was held in Brisbane on March 27, thirteen members being present. The Report of the Council was adopted by the meeting following a general discussion of matters referred to therein. The question of reducing the present Branch fee of five shillings per annum, insofar as country members are concerned, was discussed and it was decided that the Council of the Branch should take up with the Federal Council the matter of remission to local Branches of portion of the capitation fees of members; should the Federal Council anticipate an annual refund to Branches, the Queensland Branch to afford some measure of relief to its country members.

It was resolved to hold five or six ordinary meetings of the Branch during the current year.

The following office-bearers and councillors were elected for the year 1936-37: President, Mr. R. Veitch; Vice-President and President-elect, Mr. W. G. Wells; Honorary Secretary-Treasurer, Mr. C. W. Winders; Honorary Editor, Mr. H. K. Lewcock; Members of Council, Messrs. F. A. Perkins, C. R. von Stieglitz and another to be elected. Mr. E. W. Bick was re-elected Hon. Auditor to the Branch.

Pending a ruling from the Executive Committee as to the tenure of office of Branch representatives on the Federal Council, no action was taken in regard to fresh nominations for the positions. Dr. F. H. S. Roberts and Mr. L. F. Mandelson were unanimously elected to corporate membership and four further nominations for membership were received. The corporate membership of the Branch now totals 36, of whom 30 are

graduates. It is anticipated that the corporate membership will approach 50 by the end of the year.

WESTERN AUSTRALIAN BRANCH

The Annual General Meeting of the West Australian Branch of the Institute was held on April 20th. After the presentation of the Annual Report and Balance Sheet, the election of office-bearers for 1936 took place. The following were elected: President, Mr. G. K. Baron-Hay; Vice-President, Mr. H. A. Pittman; Secretary-Treasurer, Mr. R. P. Roberts; Sub-Editor of Journal, Dr. E. J. Underwood; Members of Council, Dr. L. J. H. Teakle, Messrs. F. L. Shier and G. H. Burvill.

The retiring President, Dr. Underwood, then introduced Mr. G. de V. Davis, Managing Director of Pacific Potash Ltd., and suggested that, as Mr. Davis had played a prominent part in the formation of the Institute, he should comment on Institute affairs before proceeding with his address. Mr. Davis then outlined the steps leading to the formation of the Institute and briefly commented on its activites to date and its possibilities in the future. He stressed the importance of the Journal in Institute affairs. In the course of his talk on "Fertiliser Research Abroad," Mr. Davis referred to the work being carried out by Dr. Wallace at Long Ashton and Dr. Hattam at East Malling in connection with the effect of fertiliser treatments on fruit trees, etc. A brief account also was given of some phases of the research work in progress at Jealotts Hill, Aberystwyth and in Germany.

The W.A. Branch now has a membership of 30 corporate members and 9 student members. Those who have joined the Institute since the March issue of the Journal appeared, are Messrs. M. Cullity, B.Sc.(Agr.), H. J. Hughes, B.A., W. M. Nunn, B.Sc.(Agr.) and H. G. Elliott, Dip.Agr. (corporate members); L. Jones and A. J. Anderson (student members).

REPRINTS OF ARTICLES

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Book Reviews

The Design of Experiments., by R. A. Fisher, Sc.D., F.R.S.

(Pp. ix. + 252, with 5 figures and 39 tables: London and Edinburgh: Oliver and Boyd, 1935. English price, 12/6.)

The experimental worker in almost every region of biological science is familiar with the name of Professor Fisher and knows something of the part his researches have played in establishing satisfactory methods of experimentation and handling of data. This is particularly true in the realm of agricultural research. Many of his methods, although applicable to all branches of biology, have been developed primarily for agricultural experiments. His first book, "Statistical Methods for Research Workers," has become a standard text book on the subject. It gives formulae for comparing and testing significance of data, for curve fitting, and other analyses of results . There was not room in such a book for anything more than the briefest explanation of the formulae recommended, or for any detailed discussion on the planning of experiments. Moreover, since the first edition was published in 1925, the technique of planning experiments has developed considerably, and each new edition has contained some new items.

In his latest book, "The Design of Experiments," Professor Fisher has devoted his attention to those aspects which it was not possible to develop in the earlier book on Statistical Methods. The general principles underlying tests of significance are illustrated by means of a few simple examples, and methods of designing field experiments, including the newer developments in field layout, are discussed in considerable detail

In the first part of the book, the author explains the meaning of the "Null Hypothesis," which is the basis of any tests of significance. An experiment is designed to test some particular effect. A hypothesis is assumed, which is called the "Null Hypothesis," and the test of significance consists in finding the probability of getting a series of observations such as those observed, if the hypothesis were true. If the probability is very small, the hypothesis is disproved. It is not possible ever actually to prove or establish the null hypothesis. We can only say that the experiment in question does not prove it to be false. A simple psycho-physical experiment is used to illustrate this. In a field experiment with fertilisers, the null hypothesis is that there is no difference in response to the different fertilisers.

Student's "t" test is considered, the null hypothesis being that 2 sets of observations have come from the same normally distributed population. The question of dispensing with the condition of normality is discussed, and an example of another test given, which does not include this condition of normality. The probabilities from the two tests are shown to be very similar. It is pointed out that the new one involves too much calculation to be generally applicable. The "t" test is concerned with means. Later in the book, other tests are considered, such as the significance of variances, and of skewnesses.

Several chapters are devoted to field experiments. The whole detail of planning a randomised block experiment is given, and the building up of complex field experiments, with interacting effects, is thoroughly investigated, including methods of confounding interactions with other effects. The use of analysis of covariance in field experiments is indicated, and an illustration is given in which growth rate of pigs is corrected for initial weight. These chapters are particularly useful to the agricultural experimentalist.

Fiducial probability in contradistinction to inverse probability is introduced, giving limits within which hypothetical population values are expected to lie.

The last chapter is devoted to the quantity of information obtained in a body of data, and the best method of eliciting all the available information. Illustrations for this are taken from genetical problems, on the estimation of linkage.

Throughout the book practical examples are given, which the student is advised to work out, and which would help him considerably towards a thorough grasp of the subject.

F. E. Allan

Arbeiten uber Kalidungung (*Potash Research*), *Vol. II.*—by Prof. Dr. O. Eckstein.

(Pp. 480 with 123 figures and 199 tables. Berlin: Verlagsgesellschaft fur Ackerbau M.B.H., 1935. Price, RM. 6.75)

With this second volume of "Potash Research," the well-known station at Lichterfelde indicates that the traditions of its foundation days, as revealed in Vol. 1, 1931, are being worthily maintained. Apart from the fact that the new issue contains a full record of six years' work and thus is more valuable than its predecessor, it will appeal to a wider circle of readers because of the English translation of the summary of each chapter. A detailed index of subjects also appears in English, as well as the original.

The work of the Station falls under three headings and these are used to subdivide the book into three main sections. The first, dealing with Soil Research, is devoted to aspects of the Lichterfelde method of Soil Examination. A chapter is devoted to an examination of the facts that should be revealed by a soil analysis and it is shown that these include relations far more intricate than the mere determination of chemical composition. These are then expounded by a detailed account of an examination of actual soils of known performance and a high degree of correlation is shown between field results and laboratory predictions. The practical significance of the method is also shown by a full account of work carried out on the soils of Egypt and the Sudan.

The section devoted to plant physiology covers, in the main, the mutual effects of transpiration, diffusion and rainfall and the up-take of potash and the effect of potash manuring on the stalk of cereals. General fertilizer questions are also treated. An interesting discussion is concerned with the effect of soil and climatic conditions and type of manuring upon the ratio of grain to straw in wheat-culture. The physiological significance of the rare elements (Rubidium, Caesium, Aluminium, Germanium, etc) is amongst the other subjects discussed.

The third section deals with investigations on the influence of commercial fertilisers on the chemical compostion and nutritional value of foods and feeding stuffs. The milling quality of wheat is one such matter of Australian interest and there are also metabolic investigations with fodders grown with various fertilisers. The alleged danger of continued feeding of livestock with fodders grown with the help of chemical fertilisers was investigated and reported. Prof. Scheunert, at the Vet-Physiological Institute of Leipzig, working in collaboration with Lichterfelde has shown that no such danger exists. On the contrary, animals thus fed were superior as regards longevity, fertility and fecundity whilst no significant differences were observed in the rate of growth of the young. A clear negative is given to the original question.

The value of the book to a wider audience than the laboratory worker is indicated clearly by the author himself when he says, "In nearly every country to-day . . . agriculture can only be made to pay by the intensive use of all auxiliary methods which science can place at the disposal of the practical farmer."

G. de V. DAVIS.

Current Notes and News

MELBOURNE UNIVERSITY AGRICULTURAL SOCIETY

The 14th Annual Meeting of the M.U.Ag.S. was held on the 24th April, when a most successful report of the year's activities was presented. The report disclosed that the membership had reached the record total of 134, an increase of 15 on the previous year. In addition, a record number of undergraduates (17) qualified for the B.Agr.Sc. degree, bringing the total number of graduates of the Melbourne University School of Agriculture to 135, 88 of whom are members of the M.U.Ag.S.

Mr. A. B. Hackwell announced his retirement from the position of Hon. Sec. of the M.U.Ag.S., a position he has held since the inauguration of the Society in 1923. Many references were made to the amount of time and effort that Mr. Hackwell had devoted to the task of establishing the Society on a firm basis, during his 13 years of office. The present satisfactory position is due in no small measure to the energy and foresight of Mr. Hackwell and members shortly are to be given an opportunity of recognising his services in a practical manner.

The office-bearers for the ensuing year are as follow: President, Mr. A. J. Vasey; Vice-presidents, Messrs. J. L. Gillespie and J. A. Aird; Hon. Treasurer, Mr. A. O'Brien; Hon. Secs., Messrs. A. A. Lee and R. H. Hayman; Graduate Rep., Mr. J. L. Provan; Undergraduate Rep., Mr. E. E. Henty.

In the absence abroad of the retiring President, Dr. Ivan Maxwell, the address of the evening was given by Professor Wadham who chose as his subject "The Agricultural Oyster." He described the progress and change in outlook of agricultural workers in Australia since his arrival here 10 years ago, as the opening of a series of interesting oysters.

Having served on several Boards and Commissions, such as the Soldier Settlers' Board (to determine a "living area" in the Northern Mallee), the Commonwealth Dairy Commission and later the Wheat Commission which began in 1934, Professor Wadham has had singular opportunities of studying our agriculture, particularly from the economic point of view. Arriving in September, 1926, the Professor found that the economics of agriculture had not been considered at all, and it was not until about 18 months later that investigations into the technological side of dairying were commenced.

Reviewing the past decade, Professor Wadham considered that drought was not the bogey that it was considered to be, and was not the sole factor in crop failures. Crop nutrition, he said, must be considered on a new basis. The old problem of soil fertility under our own conditions must be studied and the limiting factors governing a crop in each district in each year must be taken into account. Although the growth of knowledge of our pastures had made enormous strides, there were many problems still to be tackled. Of these, drainage was most important. How far could we push into the lighter country and keep within the boundaries of economic production? With regard to the agriculture of the State as a whole, the extent to which diversification, say by the introduction of other crops, could take place was important also. The difficulty of establishing a new crop was extraordinary and involved a long process of trial and error, the Professor stated. Diversification should enable land to carry more people and increase the amount of production. This was limited, of course, to a great extent by pests. Whether we will be in a high or low production zone depended on the discovery of cheap methods of building up and maintaining soil fertilty.

AGRICULTURAL SCIENCES CLUB, S.A.

The first meeting of the Club for 1936 was held at the Waite Institute on the 23rd April at 8 p.m. Mr. C. S. Piper was elected President of the Club for the current year. The remaining officers were: Vice-President, Dr. I. F. Phipps; Committee, Professor A. E. V. Richardson, Dr. J. Davidson, Mr. D. B. Adam; Secretary, Mr. D. C. Swan.

The evening was devoted to a joint address given by Mr. D. B. Adam and Mr. T. T. Colquhoun on "Take-all Investigations." After a general survey of the nature of the problem, Mr. Adam discussed the methods at present available for describing in quantitative terms the effect of the inoculation of wheat plants with *Ophiobolus graminis*. ..It was considered that with the exception of cases where large differences were to be expected, the "infection rating" system such as that used by McKinney was unsatisfactory. The steps taken to develop a system of measurement applicable to short course experiments was described. Work being done on the nutrition of Ophiobolus in pure culture was also discussed. Mr. Colquhoun described the technique used to demonstrate the presence of viable Ophiobolus mycelium in decayed roots. The method was being used to determine the actual host range of Ophiobolus in the field. Concurrently with this work, steps were being taken to determine the range of grasses susceptible to infection under experimental conditions. Mr. Colquhoun also gave an account of the results of an experiment designed to test the rate of spread of Ophiobolus through the soil. The work was commenced before that described by Padwick appeared (Can. Journ. Res., Vol. XII, p. 575) but followed similar lines. The effects of amputating the roots of the wheat plant at various stages in their growth had also been investigated and the results obtained were discussed.

S.U. AGRICULTURAL GRADUATES' ASSOCIATION

At a meeting of the Sydney University Agricultural Graduates' Association held in the School of Agriculture, University of Sydney, on Friday, 15th May, 1936, the following were elected as office-bearers for the ensuing year: Patron, Professor R. D. Watt; President, Mr. R. H. Anderson; Vice-President, Dr. T. H. Harrison; Hon. Secretary, Mr. J. G. Churchward; Hon. Treasurer, Mr. A. R. Woodhill; Executive Committee, Messrs. C. J. Magee and J. M. Vincent.

There were twenty-five members present. This was the first meeting of the Association since the revised constitution was adopted by the graduates on April 17th, 1936. During the evening an interesting motion film of "Agriculturists and Agricultural Lands Abroad" was exhibited, with a running commentary by Mr. J. G. Churchward.

An important item of the evening's business was the election of Mr. W. M. O'Hara to Honorary Membership of the Association, which was carried unanimously. Mr. O'Hara did not live long, however, to enjoy honorary membership for on 24th May he was killed in an aeroplane accident near Dubbo.. In paying a tribute to the late Mr. O'Hara a few days after his death, Professor Watt said that by his passing Australasia and Java had lost a modest man of rare gifts and charming personality. After four years spent on rubber plantations in Java, he came to Sydney in 1926 and spent a year studying in the Faculty of Agriculture. He subsequently accumulated considerable wealth through his rubber interests in Java, but he was one who regarded his wealth as a sacred stewardship, doing kind and generous acts in an unostentatious way.

ROSEWORTHY AGRICULTURAL COLLEGE, S.A.

In his recent review of the 51st scholastic year of the Roseworthy Agricultural College, presented at the annual diploma day celebrations at which the Premier of South Australia was in attendance, the Principal (Dr. A. R. Callaghan) made reference to the outstanding achievements and activities of the College for the past twelve months. The function received wide publicity in the press, and from the many reports and comments which have recently come to hand from various sources, there is no doubt that under the administration of Dr. Callaghan the progress of Roseworthy College has been of a most spectacular and solid character.

Space does not permit of a detailed statement of the activities, but the following extract from the Principal's report is indicative of what has transpired in recent years: "The College year, which closes with this function, has been as successful as any College year could be, but I do not intend to inflict details of our farming achievements upon you to-day, as such matters receive due publicity elsewhere. As evidence of what has been achieved it will be sufficient to say that the year opened with College space fully taxed to accommodate the 73 students enrolled; at the Adelaide Royal Show the College took three championships, two reserve championships and thirteen additional prizes for livestock; the amount of produce harvested from the farm in the form of grain, hay and silage constituted a record; the average yield per acre of wheat exceeded all previous figures in spite of considerable loss through hail damage; and to-day eighteen diplomas, as many as ever before have been awarded at a Speech Day, are being presented, two of which are with first class honours and nine with second class honours. Behind all this has been a very keen sense of interest, co-operation and willingness on the part of students. They have worked well and played well, have shown discretion and have, for the most part, conscientiously respected the trust and fairness of self-discipline. . . . An encouraging and hopeful feature in our farewell to these eighteen young men is that practically all of them have some definite work to go to; some have received good offers of permanent employment, others, seeking experience, have accepted positions which will help them qualify to take up land in the near future with greater confidence."

DOCTORATES RECENTLY CONFERRED

Colin Barnard was admitted last month to the D.Sc. degree of the University of Sydney for a thesis entitled: "Studies in Growth, Fruit Bud Formation and Yield in *Vitis vinifera*." Dr. Barnard graduated B.Sc. with first class honours in botany at Sydney in 1925, and in 1928 secured his M.Sc. for a thesis on palaeobotany. He was demonstrator in botany at Sydney University in 1924-27, and in 1927 joined the C.S.I.R., being stationed at Merbein. At present he is located at Canberra studying yield problems in grape vines, and other fruit problems.

G. A. Currie, Senior Research Officer in charge of weeds research, C.S.I.R., was recently admitted in absentia to the D.Sc. degree, Aberdeen, the thesis being: "Galls in Eucalyptus Trees—A new association between nematodes and Agromyzid flies." Dr. Currie is a graduate in both pure science and agricultural science of Aberdeen, having prosecuted his undergraduate studies after serving at the War; in the pure science tripos he obtained special distinction in botany, zoology and geology. Prior to leaving for Australia, he worked for a time with Dr. Rennie on the Isle of Wight disease of bees, and was demonstrator in agricultural zoology at Aberdeen for a period. From 1923 to 1926, he managed a sugar growing company in North Queensland, and in 1926-27 was assistant to the Comm. Cotton Entomologist. He then spent two years in the Queensland Agricultural Department before joining the C.S.I.R. in March, 1929.

INSTITUTE OF STATISTICS, OXFORD

In a letter from Dr. J. Marshak, Director of the Institute of Statistics which was recently founded by the University of Oxford, it is pointed out that the new institute is to assist research in economics and social science, particularly on the empirical and quantitative side. A request is made for supplies of reprints of any agricultural publications, of recent or earlier date, which are of importance from the point of view of statistical method. The address is: 46 Broad Street, Oxford, England.

Passing of King George V

ROYAL REPLY TO MESSAGE OF CONDOLENCE

Buckingham Palace,
19th March, 1936.

Dear Sir,

I am commanded to convey to the Members of the Australian Institute of Agricultural Science the sincere and heartfelt thanks of The King for the kind message of sympathy in his great loss contained in your letter of February 21st.

His Majesty appreciates deeply the loyal assurances which accompany this message.

Yours very truly,
(Sgd.) Wigram.

The Honorary Secretary,
Australian Institute of Agricultural Science,
State Research Farm,
Werribee.
Victoria.

Personal Notes

CANBERRA, F.C.T.

Dr. A. J. Nicholson has been appointed Chief of the Division of Economic Entomology, C.S.I.R.

Mr. C. S. Christian has been transferred from the laboratories of the Division of Plant Industry at Canberra to work at Gatton College, Queensland, on breeding of pasture plants.

Mr. H. K. C. Mair has been appointed Superintendent of Agriculture and Curator of the Botanic Gardens at Darwin, Northern Territory, under the Department of the Interior. He resigned from the C.S.I.R. and left Canberra late in April to take up his new duties.

Dr. A. McTaggart visited Gatton, Queensland, during March to examine the work of Plant Introduction being carried out by his section there and to arrange for extension of the work in Queensland.

NEW SOUTH WALES

Mr. N. S. Noble has been appointed Lecturer in Entomology at the Sydney Technical College. This is in the nature of part-time work, conducted in addition to his ordinary duties as Assistant Entomologist in the State Department. The classes are held at night and include persons taking the science and diploma courses at the College.

Messrs. E. G. Pont and R. D. Wilson were recently admitted to the M.Sc.Agr. degree in the University of Sydney, the former for a thesis in dairy bacteriology, and the latter for a thesis in plant pathology. Mr. Pont completed his tenure of the Walter and Eliza Hall Agriculture Research Fellowship last year, being then succeeded by Mr. Wilson, who is now continuing his researches at Wisconsin, U.S.A.

Miss Effie Ferrier was appointed early this year as Headmistress of the Demonstration School, Armidale, and Lecturer in Methods at the Teachers' College, Armidale.

VICTORIA

Professor Wadham has been appointed a member of the Commonwealth Advisory Council on Nutrition.

Mr. J. A. Baker has been appointed Agricultural Editor of the Melbourne "Argus."

Mr. T. S. Bellair, Dairy Technologist with the Australian Sunny South Services Ltd., left for America last April. He will be abroad for six months and will represent the A.I.A.S., in an official capacity, at the Annual Meeting of the American Dairy Science Association to be held at the Pennsylvania State University.

Mr. F. E. King has been transferred to South Australia, where he will continue his work on spray materials for the Shell Co. of Aust. Ltd.

Mr. A. S. Tisdall of the Commonwealth Research Station, Merbein, has been transferred to the Waite Institute.

Messrs. R. H. Fowler and D. C. Wark took out their M.Agr.Sc. degrees recently. Mr. Fowler, formerly Assistant Research Chemist with the Department of Agriculture, has accepted the position of Botanical Assistant at the Technological Museum, Melbourne. Mr. Wark, who has been carrying out post graduate work at the University of Melbourne under Professor Wadham, has been appointed Assistant Agronomist at the Waite Institute.

Mr. A. R. Dick, who graduated B.Agr.Sc. recently, has accepted a position with Lever Bros. Ltd. He will leave for the Solomon Islands during June to carry out a soil survey on some of the Company's plantations.

SOUTH AUSTRALIA

The Director of Agriculture, Professor A. J. Perkins, retired from service on the 11th May, 1936. Technical officers of the Department of Agriculture and representatives from the Waite Institute, the Advisory Board of Agriculture, the Governing Council of Roseworthy College and the Stock and Brands Department attended a farewell gathering and presentation to Professor Perkins on 15th May. Further details will appear in the next issue of this Journal.

Mr. W. J. Spafford, who until Professor Perkins' retirement was Deputy Director of Agriculture, has been appointed Director of Agriculture in the S.A. Dept.

Mr. G. H. Clarke, B.Sc., formerly Lecturer in Botany and Mathematics at Roseworthy Agricultural College, has been appointed Botanist at the Waite Institute.

Mr. H. G. Andrewartha, M.Agr.Sc., formerly on the C.S.I.R. staff in connection with investigations carried out by the Thrips Investigation League, has been appointed Assistant Entomologist at the Waite Institute.

Professor E. J. Goddard, Dean of the Faculty of Agriculture in the University of Queensland, and recently seconded to the Department of Agriculture and Stock for co-ordinating agricultural research activities in that State, spent several days at the Waite Institute in early May.

Mr. R. C. Scott, R.D.A., Supervisor of Experimental Work in the South Australian Department of Agriculture has recently been requested to undertake soil classification work in connection with a survey of undeveloped lands in the upper South East of this State.

Professor J. A. Prescott has accepted the presidency of Section K (Agriculture and Forestry) of the A. and N.Z.A.A.S Congress, which is to be held at Auckland in January, 1937.

QUEENSLAND

Mr. H. J. G. Hines, formerly Lecturer in Agricultural Chemistry at the University of Queensland, has been appointed to a lectureship in Biochemistry in the newly-created Medical School attached to the same University.

Mr. H. K. Lewcock, of the Department of Agriculture and Stock, sailed by the "Mariposa" on April 29 for Honolulu, where he will spend several months studying the Hawaiian pineapple industry.

Messrs. D. O. Atherton, W. Cottrell-Dormer, P. J. Skerman and H. E. Young, graduates in Agricultural Science of the University of Queensland, were admitted to the degree of M.Sc.Agr. at the recent presentation of degrees ceremony.

Messrs. F. W. Blackford and J. E. C. Aberdeen, recent graduates in Agricultural Science at the University of Queensland, have been appointd Assistants-to-Pathologist in the Division of Entomology and Plant Pathology of the Department of Agriculture and Stock.

Mr. J. F. Miles, who also graduated this year, has been appointed Assistant Research Officer in the C.S.I.R. Division of Plant Industry.

TASMANIA

Mr. E. F. Fricke left by the Strathnaver on 24th March for 12 months' study leave. He intends to study methods of pasture plant improvement at Aberystwyth and plant husbandry at Rothamsted. He expects to return via New Zealand and visit the Plant Research Station at Palmerston North.

Miss M. G. Gray has been appointed Secretary of the Tasmanian Branch of the Institute.

A Commonwealth Plant Quarantine Station has been established in the Myrtle Bank district. Recent introductions from overseas are now being grown on this station for observation, and after determining their suitability, or otherwise, they may find a place in the State's agriculture. At the present time the work is being mainly confined to potatoes, and is under the direction of Dr. R. A. Scott.

WESTERN AUSTRALIA

Dr. J. H. Riches, Assistant Lecturer and Experimentalist at the Muresk Agricultural College, has accepted a position as Assistant Research Officer with the Council for Scientific and Industrial Research.

Mr. R. Roe, at present attached to the wheat branch of the State Department of Agriculture, has accepted a position with the C.S.I.R. and will leave shortly for Canberra.